U.S. ARMY

INTRODUCTION

Companies submitting Army proposals to the Medical Research Acquisition Activity Topics A90-177 Through A90-192 is subject to an Environmental Requirement. Under the provisions of the National Environmental Policy Act, USAMRDC requires a letter from the contractor, signed by a senior official, certifying the current status of compliance/noncompliance of their organization with applicable federal, state, and local environment laws and regulations. The certification should also include a statement indicating whether the environmental impact of the proposed research has been considered and what, if any, significant impact the research will have on the environment. If, applicable, environmental concerns to be addressed will include, but not be limited to, handling and disposal of medical wastes; handling and disposal of hazardous toxic substances; handling, transportation, and disposal of biological material, and clean air and clean water concerns.

Inquiries of a general nature or where a problem may exist that requires the Army SBIR Program Manager's attention may be addressed to:

Commander
U.S. Laboratory Command
ATTN: AMSLC –TP-TI (J. Patrick Forry)
2800 Powder Mill Road
Adelphi, MD 20783-1145

Is no case should proposals be sent to the above address.

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MAILING PROPOSALS

TOPICS A90-001 Through A90-018
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U.S. Army Armament Research and Development and Development
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Picatinny Arsenal, NJ 07806-5000
Telephone: T. Ryan 201-724-7553

TOPICS A90-019 Through A90-021
Commander
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ATTN: AMSTR-PBP, SBIR Program
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Telephone: C. Harrison 103-664-1068

CECOM RDE CENTER

TOPICS A90-022 Through A90-044

TOPICS A90-0022 Through A90-032
A90-040 Through A90-044
Commander
U.S. Communications-Electronics Command
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Fort Monmouth, NJ 07703-5000
Telephone: J. Crisci 201-544-2665

TOPICS A90-033 Through A90-036
Director
U.S. Army Center for Signal Warfare
ATTN: AMSEL-RD-SW-SA
SBIR Program (Dr. Royal Burkhardt)
Vint Hill Farms Station
Warrenton, VA 22186-5100
Telephone: J. Crisci 201-544-2665

TOPICS A90-037 Through A90-039
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TOPICS A90-045 Through A90-049
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TOPICS A90-061 Through A90-068
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U.S. Army Missile Command
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TOPICS A90-061 Through A90-074
Commander
U.S. Army Natick Research and Development And Engineering Center
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TEST AND EVALUATION COMMAND

TOPICS A90-075 Through A90-088

TOPICS A90-076, A90-078, A90-080, A90-084, A90-087
Commander
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Directorate of Contracting
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TOPICS A90-075, A90-077, A90-085, A90-088
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U.S. Army Aberdeen Proving Ground Support Activity
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Ryan Bldg, Rm 124
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Telephone: S. Marshall 301-278-3906

TOPICS A90-079, A90-083
Commander
U.S. Army Yuma Proving Ground
Directorate of Contracting
ATTN: STEYP-CR, SBIR Program
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TOPICS A90-082
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ARMY LABORATORY COMMAND

TOPICS A90-081 Through A90-139

TOPICS A90-089-A90-091
Commander
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Procurement Directorate
ATTN: AMCMC-PCM (A), SBIR Program, Ballistics Research Laboratory (BRL)
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Aberdeen Proving Ground, MD 21010-5423
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TOPICS A90-092 Through A90-099
Commander
U.S. Army Research Office (ARO)
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Research Triangle Park, NC 27709-2211
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TOPICS A90-100 Through A90-103
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U.S. Army White Sands Missile Range
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TOPICS A90-114 Through A90-120
Commander
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Procurement Directorate
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TOPICS A90-121 Through A90-129
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TOPICS A90-130 Through A90-135
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TOPICS A90-136 Through A90-139
Commander
U.S. Army White Sands Missile Range
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TOPICS A90-140 Through A90-158
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TOPICS A90-159 Through A90-160
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CORPS OF ENGINEERS

TOPICS A90-161 Through A90-170

TOPICS A90-161 Through A90-170
Commander
U.S. Army Construction Engineering Research Laboratory (CERL)
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Telephone: D. Moody 217-373-7205

TOPICS A90-165
Commander
U.S Army Cold Regions Research and Engineering Laboratory (CRREL)
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Hanover, NH 03755-1290
Telephone: C. Martinson 603-646-4244

TOPICS A90-166 Through A90-169
Commander
U.S. Army Engineering Topographic Laboratory (ETL)
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TOPICS A90-170
Commander
U.S. Army Engineer Waterways Experiment Station (WES)
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Vicksburg, MS 39180-0631
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TOPICS A90-171 Through A90-176
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TOPICS A90-177 Through A90-192
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TOPICS A90-193 Through A90-206
Commander
U.S. Army Strategic Defense Command
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Huntsville, AL 35807-3801
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Department of the Army
FY 1990 Topic Description

A90-001 TITLE: Fire Control Initiative

OBJECTIVE: Develop gun fire control systems with significant improvements over current performance capabilities. Specific issues to be addressed are gunnery speed and accuracy and gunnery tactics and decision aids.

CATEGORY: Exploratory development

DESCRIPTION:

GENERAL: Continuing rapid advances in electronics, particularly computers and data storage have presented the opportunity to address fire control performance particularly in the critical areas of improved gunnery accuracy and speed and improved gunnery tactics and decision aids. Clearly, the availability of extremely fast signal processors and powerful computers small and rugged enough to be mounted on weapon platforms will revolutionize fire control; improving speed and accuracy while reducing the burden on the soldier. Technology issues of interest include novel target sensors, sensor fusion, target identification and hand-off, aided target cueing, path planner, weapon (aiming and firing) inter-vehicle information, positioning/navigation.

PHASE I: Develop methodology and approaches for addressing one or more fire control technology issues. Identify potential performance improvements in gunnery accuracy and speed and/or gunnery tactics and decision aid. Formulate system concept.

PHASE II: Develop a full-up laboratory prototype system with appropriate weapon interfaces and display Optimize hardware/software, algorithm and interface design based on laboratory test results. Provide fully integrated prototype system with documentation, source code (if appropriate) and test results.

A90-002 TITLE: Generic Gun Bore Evacuator and Flareback Control Code

OBJECTIVE: Develop a finite element chemically coupled gas dynamic code to control flareback with generic gun bore evacuator pump devices.

CATEGORY: Exploration Development

DESCRIPTION:

GENERAL: Our understanding of the fluid mechanics of bore evacuator design has made significant progress by using ideal gas flow methods. These methods are being validated with air flow experiments at Rennsalaer Polytechnic Institute. Because this approach is in satisfactory agreement with experiment it appears logical to develop its use for preliminary design. However, flareback conditions can occur at every firing: At projectile exit, muzzle flash can initiate flame travel in the direction of fuel-rich gases within the barrel. The gases expand to ambient, but auto ignition conditions continue at the muzzle. Flame velocity can then exceed the velocity of exiting combustibles, thus permitting the flare to advance into a barrel. This means that a well designed bore evacuator should pump air (and Residual propellant gas) from the breech at speeds that exceed the flame speed plus muzzle head - wind. Otherwise, the nozzle exits can become flame holders. As the discharge cycle subsides, such flame holders can permit flame travel through the nozzle array and combustion of residual gas within the reservoir, possibly weakening and causing subsequent malfunction of the device. Thus, active flareback control is the desired goal: A 3D computer fluid dynamics code that accounts for dissipative gradients and real gas chemistry effects can yield toxic product compositions. Control will be accomplished with parallels coding of flow physics, and animated visualization of the flareback combustion processes. Planned developments include: (1) Construction of a real gas 1D bore evacuator design model to yield propellant gas simulations with compositions at valid equilibrium states. The BLAKE dense gas thermo chemical code is used to obtain initial combustion product compositions. (2) NASA's dilute-gas code will

determine premixed equilibrium combustion of real gas products with entrained air, thus established the dependency of toxic residuals on flareback.

PHASE I: Develop a multidimensional finite element Computational Fluid Dynamics program to defeat flare back by coding for parallel architecture machines: A modular approach can be used, beginning with the simplest model that can capture basic physics within the bore evacuator, viz., asymptotic steady-state, 2D in viscid, real gas flow. Exercise the code for comparison to the 1D results and experiment.

PHASE II: Develop the Phase I code by linking it to a specified reaction kinetics code. Exercise the code for comparison to the 1D results. Extend the Phase I algorithm to 3D Navier-Stokes flow.

A90-003 TITLE: Ignition of High Energy Density Charges

OBJECTIVE: Development of Ignition Systems for High Energy Propellant Systems

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: The trend in ballistic system design is toward use of those propellants, which produce a high energy per unit volume. Consequently, there is considerable interest in use of consolidated, bonded and unified charges of various fluid propellants (liquid, gel, emulsion and slurry propellants) and new solid propellants. This increased energy density, however, can result in instabilities which run counter to the need alleviate these problems. For example, careful tailoring of the ignition system (e.g., pyrotechnic, electric, laser, etc.) can do much toward achieving an effective ballistic system. Analytical and experimental efforts in the fundamental study of ignition and combustion characteristics of high energy density propellants are desired.

PHASE I: Feasibility Study of potential stimuli for use in improved ignition system of high energy density charge and novel configurations.

PHAE II: Construct and demonstrate new igniter systems based upon results of Phase I study.

A90-004 TITLE: Investigation of Combat Vehicle Fire Control Position, Navigation and Directional Reference Techniques Using Global Positioning System (GPS)

OBJECTIVE: The final objective is to develop one or more techniques for combat vehicle fir control system position, navigation, and directional reference techniques using GPS combined with appropriate auxiliary or additional devices to insure operation in spite of GPS loss due to countermeasures. The Phase III objective is to demonstrate the technical performance of such a system in “brass boar” form.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: There is a current need to investigate available position location and orientation technology for application to weapon fire control systems where inertial based technology (such as the Modular Azimuth Positioning System (MAPS)) are either too expensive or too large to be applied successfully. Systems based on the GPS are available which are low cost and small in size. However, such GPS based systems have some fundamental limitations. GPS systems, because they depend on satellite transmissions, can be susceptible to countermeasures and, at present, GPS systems provide only location data. They have no capability for orientation or azimuth reference determination. The purpose of this solicitation is to address those GPS limitations and to investigate techniques for overcoming them.

PHASE I: It is desired that Phase I produce three results. The first is an analysis of the susceptibility of a GPS position location receiver to countermeasures. This analysis should characterize the degree of loss of accuracy that would be expected in typical countermeasure situations. The second requirement is to investigate possible "backup" devices or technologies, which would operate in conjunction with the GPS receiver to retain some level of position location capability if the GPS is degraded by countermeasures. The requirement of low cost size/weight if compared to MAPS applies to the "backup" device. The third requirement is to investigate potential techniques for using GPS, or GPS integrated with another device, to obtain orientation of azimuth reference data. Accuracies down to 1 mil are desired, but lesser accuracy may be acceptable, depending on other features of the technique.

PHASE II: In Phase II it is desired that the feasibility of the most promising technique for GPS "backup" position location and for GPS azimuth reference determination be demonstrated in at least "brass board" form.

A90-005 TITLE: Ultrasonic measurement of through-wall stress state in loaded artillery projectiles

OBJECTIVE: Develop an ultrasonic device, which can reliably measure the through-wall stress state in loaded artillery projectiles.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: Artillery projectiles are made by various metal forming techniques. The state of residual stress in these items, are a reflection of these forming techniques and the annealing procedures used to reduce these stress. A device is desired capable of monitoring the stress state of loaded projectiles to determine the integrity of the projectile under launch conditions. The particular device to be constructed must be capable of determining the principal stresses and their directions.

PHASE I: Develop ultrasonic techniques for determining the through residual stress in thick wall cylindrical shell.

PHASE II: Construct and demonstrate an inspection device capable of scanning 8-inch artillery shell and determining the residual stress state at selected through-wall locations.

A90-006 TITLE: Fire Retardant and Wood Preservative Treatment for Wood

OBJECTIVE: Develop a treatment for wood products that combines the aspects of fire and smoke retardants with those of wood preservatives.

CATEGORY: Advanced Development

DESCRIPTION:

GENERAL: General Wood Products are used throughout the ammunition logistics system in packaging and dunnage. Wood products are easily adapted to these roles, but they have a tendency to burn. There is increasing emphasis to remove all of the burnable products from ship cargos to prevent the spread of fires and smoke on board ship. There is also a need for wood products to be treated with preservatives to prolong life. Treatments developed to date either satisfy one or the other requirement but not both. A method is needed to treat wood materials or develop a wood based material that has these properties in order to keep this adaptable substance in the ammunition logistics system.

PHASE I: Develop an overall plan to include a review of the requirements for materials that have fire retardance, smoke prevention, and preservatives; a plan for development of test samples; and test of these

samples in the contractor's facility and government facilities. Produce a minimum of 12 test titles 6" x 6" for test.

PHASE II: Construct a set of 6 boxes per government provided drawing on the order of 19" x 12" x 36" for adaptability for large and small scale production.

A90-007 TITLE: High Speed Inspection of 5.6mm Cartridge Case Primer Pockets

OBJECTIVE: Develop techniques for inspecting and sorting the dimensions of the primer pocket at high speed for adaptation into the current manufacturing process.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: On the current production process for the 5.6mm cartridge cases the primer pocket is checked for presence of the vent hole at the end of the process inspection system (CCMES). There is no capability to measure and inspect the dimensions such as concentricity, diameter and finish. These inspections are preformed randomly on a sampling basis to satisfy the quality control level by an operator using manual plug gages and visual observation. The plant often becomes aware of primer pocket dimension problems when completed rounds fail tests at the guns.

PHASE I: Investigate the techniques to measure the dimensions of the primer pocket and develop the implementation process.

PHASE II: Construct a model or models for demonstrating feasibility of critical elements of a prototype to be installed on a SCAMP Cartridge Case Submodule at Lake City AAP for evaluation and demonstration as a follow on to this effort or, if possible, construct a complete prototype machine.

A90-008 TITLE: Radiographic Image Prediction and Computer Modeling

OBJECTIVE: Develop and implement the software modeling of X-ray images of armament devices and material from CAD drawings.

CATEGORY: Advanced Development

DESCRIPTION:

GENERAL: Solid modeling of armament systems, components, and subcomponents is commonly done today on CAD system. Using similar techniques it would be possible to predict and display x-ray models from CAD drawings. Modeling would have to consider x-ray source parameters, object properties, and images formation parameters. The resulting model ought to be displayed with a resolution commensurate to that of radiographic imaging systems. Parameters such as the relative position of x-ray source, object, and viewing field should be easily selectable.

Such a modeling system could meet several objectives. For example, the modeling process would give the designer sufficient feedback to design armaments taking into account the need for impeccability. The designer would have feedback helping him to select component placement and material such that critical elements could be seen radio graphically. Putting such capability into the designer's hands should help eliminate problems later in the life cycle of the armament.

Another objective would be to feed the x-ray models directly into current Army radiographic inspection equipment in order to train the inspection equipment for inspection of items not currently handled by the equipment. Such inspection equipment requires a large number of images displaying the multifold

combinations of possible configurations of components within the objects being modeled. Training of such inspection equipment is currently expensive and time consuming, requiring the manufacture of specially designed standards exemplifying the many possible configurations.

PHASE I: Preliminary work on this topic has already been done. Phase I should build on that preliminary work. Selection of a CAD system and determination of the interface to inspection equipment needs to be done during Phase I. The results of Phase I should prove the feasibility and utility of the project. The result of Phase I should be full detailed scope of work for Phase II.

PHASE II: Develop and implement the software modeling of x-ray images of armament devices and materiel such as foxes, propellants, shells, etc., from CAD drawings. Build and deliver a complete system meeting the project objectives with interfaces to Army owned radiographic inspection equipment and Army owned CAD systems.

A90-009 TITLE: Computer Virus Prevention for Embedded Computer Weapon Systems

OBJECTIVE: To develop appropriate measures to safeguard against the presence of computer software viruses in embedded computer weapon systems. This includes developing anti-viral products, virus detection measures, and computer security polices.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: A computer virus (sometimes called a worm) is piece of code inserted into other programs or operation systems. When activated, the virus will rewrite itself to other portions of your system or programs, and typically will perform destructive act such as erasing your hard disk or destroying your data

PHASE I: The contractor shall perform a comprehensive literature search on computer viruses (in general) The following topics, as a minimum, shall be addressed:

- What is virus and/or whom? What do they consist of and how do they work? What damage do they cause?
- How do you detect the presence/absence of a virus?
- What do you do if you know your system is infected? How do you quarantine one?
- Can you recover from contracting a virus, and if so, how?
- How do you prevent contraction a virus? How can you minimize the damaging effects?
- What anti-virus tools and/or vaccines exist on the market today? What are their characteristics/features? How do they work?

Utilizing these results, Phase I shall also consist of a study to determine the repercussions a computer virus could have in mission critical weapon systems. Areas to be addressed, as a minimum, include:

- What are the areas of vulnerability of the weapon system, i.e., how could the virus get in? Which types of weapon systems are more susceptible to a virus attack?
- How could the virus spread itself to other systems?
- What steps can be taken to prevent contraction a virus?
- What security measures and/or policies need to be established to prevent virus infections in weapons systems?

Phase I should provide demonstrations of anti-viral products and/or vaccines, if possible. Phase I should include two visits to Picatinny Arsenal, NJ, one for an initial kickoff meeting, and one for a finial demonstration of the prototype. Bimonthly progress reports should be provided, as well as a final technical media (format to be approved by the government).

PHASE II: Phase II should produce a prototype anti-viral product or vaccine for the problem areas identified in Phase I. The contractor shall also provide comprehensive software documentation, using DOD-STD-2167A as a guide for the software development process. Phase II should also establish computer security requirements, policies, and/or guidance on the prevention, detection, and treatment of computer viruses in mission – critical weapon systems.

A90-010 TITLE: Integrated Target Recognition and Tracking

OBJECTIVE: Develop fire control systems for air and ground targets that use high-resolution imagery for enhanced trajectory prediction.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: The subject of this topic involves tracking the present position of a maneuvering aircraft or ground vehicle as well as predicting its future position. Tracking filters for both fixed and rotary wing aircraft have already been developed that use attitude angles (yaw, pitch, roll) in addition to the usual radar measurements. Computer simulation of tracker performance when tracking violently maneuvering aircraft indicates that a dramatic improvement is obtained by using optically-derived attitude information. It is desired to develop a similar filter for ground vehicles and to test it against real targets, as well as to improve the performance of the aircraft trackers and test them against real targets. The development of an automatic target recognizer that will accurately determine target type and orientation is very important to this topic and may include techniques for global and partial shape recognition of three-dimensional objects by using two-dimensional exterior contour information, or recognition of three-dimensional objects by using three-dimensional surface information, or use of time-varying imagery to segment shape. Neural networks may prove useful here in hybrid combination with classical shape description methods. The development of very fast Kalman-filter calculation techniques is also important to this topic because of the requirement of work in real time and indicates the necessity of using parallel computations and making appropriate simplifying assumptions in the filter structures.

PHASE I: Develop methodology for integrated target recognition and tracking of violently maneuvering aircraft and ground vehicles, including target identification and orientation determination algorithms, tracking and prediction algorithms, and choice of a target locator and imaging sensor hardware suite.

PHASE II: Develop a demonstration of the integrated target recognition and tracking algorithms working in near real-time against real target.

A90-011 TITLE: Improved Fusible Link for FASCAM Mines

OBJECTIVE: Develop a one for one replacement for the current fusible link used in the self-destruct selection circuit of FASCAM mines. The current design results in an unreliable device with inconsistent electrical characteristics and is highly prone to open circuit.

CATEGORY: Advanced Development

DESCRIPTION:

GENERAL: The current fusible link or micro fuse per dwg. 9328688 is used exclusively in FASCAM mines to permit selection of different self-destruct times. The self-destruct setting circuit is a capacitive discharge type whereby the dispenser provides and electrical pulse into the mines thought a magnetic coupling device. The energy received in the mine is used to fire a micro detonator (to initiate the battery) as well as to blow out micro fuses. Different pulse polarities and amplitudes selectively blow out different fuse combinations, thus providing the e logic to bias an integrated circuit, which gives different self-destruct times.

The current device utilizes a simple tungsten bridge wire spot welded across two terminals in a non-hermetically sealed can. The bridge wire is so small (.00013 in dia), that it is difficult to make a consistent, high quality product. The non-hermetic enclosure also allows contaminants to attack the bridge wire and terminals, which leads to changes in the fusing characteristics and often open circuits. As a result these deficiencies, many mines will lose their ability to be properly programmed and will self-destruct early, thus significantly reducing minefield effectiveness.

The mechanism by which the fuse responds to the capacitive discharge pulse and eventually opens has been studied extensively. Prediction of fuse response based on non-destructive testing has also been attempted. Both efforts have had limited success. It appears that discharge pulse produces second and third order effects, which are significant and highly dependent on device construction. Testing has shown that the device characteristics are affected significantly by weld integrity, bridge wire thickness, and bridge wire type. These efforts further confirm the need for a consistent high quality device.

PHASE I: Test the current fusibility link and develop a new specification for the devices performance based on capacitive discharge excitation. Develop new test methods to assure device consistency.

PHASE II: Procure alternate fuse or develop new fusible link to duplicate characteristics of existing fuse. Test quantity of 200 fuses to insure device performance and design integrity.

A90-012 TITLE: Curved LCD for Multi-Option Fuzing Application

OBJECTIVE: Develop new cost Liquid Crystal Display which is either flexible or curved such that it is suitable for mounting in place of a typical fuse display window. The LCD must have response time times of less than 0.5 second over temperature range of –40 to +1600 degrees Fahrenheit.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Current Artillery electronic fuses depend on recessed Light Emitting Diode (LED) or LCD to convey mode and time of flight information to the operator. Some fuses have an inductive auto setting capability, however, there is still a requirement that the fuses be manually settable without any setting tools and this requires some kind of display. The visibility of current display is not ideal, especially with a recessed LCD display. AN LCD display positioned on the fuse body in place of the current fuse display window would provide optimum visibility. Artillery fuses must operate over a wide temperature range (-40 to +160 degrees Fahrenheit). Standard LCD's do not have a suitable response time at low temperatures. This display must be able to survive storage for up to 20 years and remain fully operational.

PHASE I: Display technology will be explored and prototype displays fabricated which demonstrate the feasibility of a curved or flexible LCD. Response times a digit clarity will be explored. Intuitive and easily readable fuse mode and digits will be investigated. As a minimum the LCD should be capable of indicating the following modes: Proximity, Time, Point detonating (PD), and PD with delay. The Proximity mode should show turn-on time, height of burst (High, Medium, Low), and canopy option. The Time mode must show time of flight information up to 199.9 (seconds). Each of the four modes is mutually exclusive (i.e., Proximity and PD would not be displayed simultaneously). The Proximity mode would be displayed along with the proximity turn-on time, which should utilize the same digits as the Time mode display.

Possible non-icon based abbreviations could include: VT or PROX for Proximity mode, T or Time for the Time mode, PD for Point Detonation mode, PDD for Point Detonating mode with delay. Suitable abbreviations or icons should be selected and evaluated based on good human engineering principles.

PHASE II: The display technology and configuration selected during phase I will be evaluated. Prototypes will be made and tested over the artillery fuse temperature range on simulated fuses or fuse metal parts which conform to large caliber fuse contours per MIL-STD-333. Only a simple electronic circuit is necessary to

exercise each display segment. The cost and longevity of the prototype displays will be examined. Prototype will be made as appropriate to verify producibility and accelerated aging tests will be performed to indicate long-term performance.

A90-013 TITLE: Low Cost COMVAT Cased Telescoped Ammunition

OBJECTIVE: Development of a low cost high performance cartridge design for the 45-mm COMVAT gun system.

CATEGORY: Exploration Development

DESCRIPTION:

GENERAL: The Combat Vehicle Armament Technology (COMVAT) program is an ARDEC tech bade program developing an advanced high performance gun system for future combat vehicle such as the Future Infantry Fighting Vehicle (FIFV). COMVAT technologies include 45-mm cased telescope ammunition and a rapid fire automatic cannon. The current ammunition design consists of a cylindrical cartridge utilizing consolidate conventional propellant, a steel case and spherical end caps. Both armor piercing fin stabilized discarding sabot (APFSDS) and training projectile (TP) types of ammunition are being developed. Current designs use many machined metal parts and an expensive propellant consolidation process.

It is highly desirable to develop a more cost effective cartridge design. Such as design shall minimize the number of machined metal parts, make maximum use of metal stampings, provide for cost effective propellant processing, with low vulnerability (LOVA) formulations and provide for automated assembly techniques.

PHASE I: Develop the preliminary cartridge design, cost and performance estimates, and provide initial samples for testing.

PHASE II: Develop the cartridge for a potential family of projectiles and continue cartridge refinement through a series of design, build and test iterations.

A90-014 TITLE: Optical Design for Enhancing Laser Eye Protection

OBJECTIVE: Designs for direct view optical sights, which will enhance to operation of non-linear optical switches, sacrificial mirrors and other optical limiters placed in focal planes.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: To protect operators of a direct view optical sight from laser eye damage, optical limiters based on non-linear processes such as plasma formation and sacrificial mirrors must be placed in a focal plane of the system. Present systems are designed with the primary goal of presenting an adequate image to the eye. The purpose of this program is to add the requirement of improving the concentration of energy in the focal plan of the system in order to trigger limiters at a lower threshold of input energy.

PHASE I: An Army optical sight will be analyzed to determine its efficiency in concentrating coherent radiation at its focal planes. A 10x, +/- 4 deg field-of view system will be designed with the goal of matching its performance and increasing the concentration of flux in the focal plane. The final report will contain the optical design and analysis.

PHASE II: A devise based on this Phase I design will be fabricated. Imaging performance will be measured and compared to that of a conventional system. The point spread function in the system's focal plan will be measured.

A90-015 TITLE: Radiographic Image Processing Using Neural Networks

OBJECTIVE: Develop and implement innovative neural network image processing algorithms for analysis of radiographs of armament device and materiel.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Inspection of armament devices and materiel after assembly is frequently done radio graphically using image analysis algorithms. The type of features which need to be interpreted are such things as porosity, cracks and voids and the existence, condition and placement of components such as gears and pins. Radiographic images are uniquely different from visual light images in that one is looking at shadows of object superimposed on each other. Due to the complexity of the image, features are often difficult to pick out, even by the eye. Lack of contrast and high levels of image noise ad to the problems of image analysis. The image processing algorithms in existence often are inadequate, especially in interpreting continuity in features. This request is for the development of a neural network algorithm for image processing appropriate for such an environment.

PHASE I: Select the most promising neural network algorithm from the many available which can meet the processing requirements for this problem. Selection must be made based on a though knowledge of the various neural network algorithms, knowledge of image analysis problems especially radiographs, and considering cost and timing constraints imposed by the manufacturing environment. Develop a prototype concentrating on one or more features in a typical armament device. Provide sufficient evidence that the prototype can be scaled up to production levels.

PHASE II: Develop and integrate a full scale neural network inspection system (hardware & software) with existing government owned automated x-ray inspection equipment for the inspection of armament devices and projectiles. The resulting system must keep up with armament production rates.

A90-016 TITLE: Electronics Encapsulation Materials/Methods Incorporation Electronic Shielding

OBJECTIVE: Develop new methods (and materials if necessary) to encapsulate electronics assemblies with will provide immunity from radiated electro-magnetic energy without utilizing expensive nuclear hardened semi-conductor technology.

CATEGORY: Exploration Development

DESCRIPTION:

GENERAL: There is great concern regarding the potential susceptibility of FASCAM mines to high-powered microwave elector-magnetic energy. This type of energy has been known to cause disruption of electronic functions and even direct ignition of detonators at high enough energy levels. The various mine types have various degree of inherent shielding to such energy (as a result of surrounding metal parts), however complete metal enclosure cannot be insured in most mine configurations without radical redesign.

It is desirable to investigate the possibility of modifying the electronics encapsulation (potting) materials/methods to provide shielding from radiated electromagnetic radiation. The improved encapsulation should no result in significant increase in potting process time or cost compared with current designs.

PHASE I: Determine shield properties of different encapsulation materials to microwave energy through test/analysis. Investigate/test modification to current material or the development of new materials. Investigate/test the possibility of combining or layering materials to achieve a certain effect

PHASE II: Pot a minimum of 25 FASCAM anti-tank electronic assemblies with candidate improved potting material(s)/process (es). Test shielding afforded by various concepts by subjecting assembled mines to microwave energy. Document selected process.

A90-017 TITLE: Remote Processing of Lead Styphnate

OBJECTIVE: Development a hands-off method for washing, and portioning batches of lead styphnate, a prim initiating explosive used in small arms printers. The equipment developed in Phase II will be installed at an Army Ammunition Plant for processing lead styphnate.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Lead styphnate is very sensitive primary initiating explosive used in small primers and detonators. It is extremely sensitive to impact, friction and electrostatic discharge. The current manufacturing process requires extensive manual handling of the material be an operator during washing and portioning (weighting of a 20 lb. Batch into containers containing 4 lbs. 10 oz. Lead styphnate). Due to the sensitivity of the material, both of these operations are very hazardous.

PHASE I: Develop a method of washing and portioning lead styphnate, to be obtained either from a batch process or from a continuous reactor, which eliminates direct handling be operator. Due to the sensitivity of the materials, the processing equipment is precluded from using traditional valves, pumps, centrifuges, or other equipment that could provide pinch points and other sources of initiation.

PHASE II: Design and model the equipment proposed in phase one to handle production rates of 20 lbs. Per hour. A suitable stimulant must be selected for initial testing. Due to the hazard of these operations, remote operation of the equipment and elimination of direct handling are essential.

A90-018 TITLE: Software Development with Enhanced Reliability, Availability and Maintainability

OBJECTIVE: Develop Software for Large Systems, possessing grater reliability, and maintainability (RAM)

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: With the increase use of computers has come the important problem of developing and maintaining the software, which controls the computers. Indeed, software costs have already passed hardware costs and will soon be the dominant expense. DOD is particularly concerned because of its extensive use of computers, with great emphasis on reliability, availability, and maintainability (RAM). Contractors outside DOD usually develop elaborate software systems, and these systems tech transferred to DOD, which must maintain the software. DOD software maintainers are increasingly I touch with the outside software developers, from the beginning of the software life cycle. Software RAM is being addressed throughout the computer community, but more work needs to be done. This project will address the question: What can be done cost-effectively during software development to enhance RAM of the software?

PHASE I: Look at the software development process, including the current popular approaches, from the standpoint of RAM and suggest possible improvement. What are the economic consequences of such changes?

PHASE II: Suggest new software development methodologist based on Phase I results, and demonstrate RAM improvement

Belvoir RDE Center

A90-019 TITLE: Low Emissivity and Low Reflectance Materials

OBJECTIVE: New materials for decoy military equipment

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: A fabric-like material is sought which posses both low emissivity in the thermal infrared and low reflectance in the visual spectrum. Its color should be dark (black, dark green, or dark brown), non-specular, and diffusely reflecting less than 5 percent of incident light. The range of emmissivity should be as low as possible, preferably below 0.8. Materials capable of being manufactured in several different emissivities are desired. Physical performance characteristics should include a capacity for long-term folded storage and the ability to be draped in a wide range of outdoor environments without showing any creases. Some tension is allowable to accomplish this. Mildew-resistance and water repellency are desired.

PHASE I: The recipient will be funded to fabricate and test several material samples.

PHASE II: The recipient shall conduct a Manufacturing Methods and Technology program for possible production.

A90-020 TITLE: Lightweight Footbridge Concepts

OBJECTVIE: The development of a man portable and deployable footbridge for the Light Infantry Divisions. The footbridge concept must provide the infantryman with bridging capability to cross wet and dry gaps quietly and quickly.

CATEGORY: Exploratory Development

DESCRIPTION:

GERNERAL: The current footbridge in the Army inventory only provided for wet gap crossings. The system requires motorized transport of the equipment and requires access to bother sides of the gap in order to erect a cable prior to building the bridge. The system must be able to span a 20-meter dry gap and an unlimited wet gap. The system must be man portable and deportable quickly and quietly. The system should not require access to both sides of the gap in order to launch. The objective is for the soldier to cross the gap, perform the mission and get out without alerting the enemy.

PHASE I: This phase is devoted to developing a concept to meet the requirements. A comprehensive finial report is required which will include a complete analysis of the structure, materials, and drawings. A demonstration model is required to illustrate the concept.

PHASE II: This phase will expand on the information obtained in Phase I. This phase will refine and optimize the concept developed in Phase I through use of the model and analysis. A full-scale breadboard prototype will be fabricated which can demonstrate the concept. The prototype will be evaluated for compliance with the requirements and the Trilateral Code. The deliverables will be a finial report detailing fabrication analysis, evaluation data, and the breadboard prototype.

A90-021 TITLE: Long Pulse Solid State High Power Microwave Source

OBJECTIVE: Development of a solid state, compact source of high power microwave pulses.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: The source required is to be evaluated for use as the heart of the high power transmitter. The scope of this effort is to investigate and prove a means for conversing continuous prime power into very high power microwave pulses for use in a radiating countermine weapon. Thus the real goal is production of as much power as possible, subject to the constrains of: size and ruggedness (for weaponization considerations), efficiently (for prime power size considerations), and reliability. The current microwave requirements for the source are: greater than 100 megawatts of peak microwave power produced, pulse widths greater than 50 nanoseconds, and pulse repetition frequencies greater than 15 Hz. The source is to be stable in frequency (>1%BWY) and power and energy levels from pulse to pulse. The source shall operate in or below the X band. The efficiency desired (average microwave power/average prime power required) is greater than 30%. Intended application will ultimately require the source to be a highly reliable, ruggedized device with a size/weight envelops less than 2 cubic meters and 1000 lbs.

PHASE I: The contractor will be required to develop his approach into an advanced conceptual design for meeting the above requirements. A feasibility analysis of the design shall be conducted to assess the cost and risk associated with development of the design tradeoffs, which are inherent in the approach. The contractor shall also plan the size and scope of the phase II demonstrator.

PHASE II: Physical proof of the validity of the conceptual design of phase I is t be the goal of this follow on effort. The contractor will design and build a scaled demonstrator device, which proves the approach for efficiently producing microwave pulses. The limits of performance for the demonstrator should be a clearly related to the scope of the effort. Any issues involving in up-scaling the design to the requirements described above shall be addressed in the phase I plan and shall be readdress during phase II. The contractor will be required to test and demonstrate the unit.

CEMON RDE Center

A90-022 TITLE: Tactical Forces C3IEW Space Surveillance Countermeasures

OBJECTIVE: Research Technologies and Techniques that need to be developed to prevent Army commanders at all echelons from being observed by space based sensors.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Military organizations, (including the soviets), scientific organizations, news media, etc., are relying more and more on the use of the use of space based assets to assets to sense and observe activity on the ground. As a result, we need to examine how we protect (MASK) Army commanders having forward and deep battle units from being sensed by space based platforms. The thrust of this proposal is to conduct engineering level studies of the capability of the Army to defeat both intentional and unintentional space system surveillance. The studies should initially explore the vulnerability of one or more Tactical Corps or division level deployments to typical non-military earth surveillance system such as spot or land sat, or others. This will require having access to the detailed parameters of the selected space platform in addition to having access to or generating electromagnetic signature and heat signature, etc, data for equipment on the ground. The next step would involve identifying equipment and technology available to mask combat operations, communications, radar, etc from such surveillance. The finial step should be series of recommendations for providing masking capability.

PHASE I: Conduct a study as discussed above using a non-military assets as a bias, generate a comprehensive report of study results to include recommending follow up actions required for pursuit those technologies/developments that show the most promise.
PHASE II: Pursue the recommendations of the phase one report, to include conducting demonstrations. Conduct additional studies based on a soviet military and other know unfriendly military satellite sensing platforms. This could become quite complicated, as it will involve having access to

PHASE III: Approach prime C3/IEW contractors about investing in the above project to do some system development work and conduct field demonstrations. There is potential for high payoff from an operational standpoint. Operation payoff Equates to high probability for systems development.

A90-023 TITLE: Space Based Battlefield Deception

OBJECTIVE: Research Technologies that exist or need to be developed to facilitate the generation of space based Battlefield Deception Techniques. Advised on the feasibility of the same.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: The Army is seriously pursuing the use of space based assets to enhance that tactical commander's war fighting and decision making capabilities. General Battlefield Deception is an area that is beginning to show payoffs. Space based Battlefield Deception is a new idea that requires much research and development.

The primary purpose of this proposal is to conduct engineering and technology level studies of potential Battlefield Deception capabilities generated form a space platform One far term concept currently being considered addresses using space based platforms to generate three dimensional images, moving decoys, etc. on Generation of false radar signatures and communications is another idea that is worthy of additional research/investigation.

In general the entire area of Battlefield Deception generated from space based platforms needs additional exploration from a technology and feasibility standpoint. An overall analysis of the space deception field is required. Technologies that need to be developed must be identified as well as the cost and operational aspects of this approach.

PHASE I: Conduct a study of the space deception field and payoffs as discussed above. Generate a comprehensive report of study results and recommend the follow up actions required to pursue those technologies that show the most promise.

PHASE II: Pursue the recommendation of the Phase I report. Conduct some laboratory experiments demonstration to verify project results and payoffs.

A90-024 TITLE: Voice Authentication/Recognition

OBJECTIVE: Develop a generic UNIX shell enable multiple verbal communications with command and control system applications, and demonstrate the feasibility for replacing input/output (I/O) devices for current applications.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Current command and control applications use various input/output: (I/O) device such as a mouse, trackball or joystick to allow a user to interface with a computer system. It would be highly advantageous to

develop UNIX shell, which allows a user to verbally communicate with the applications on the system. The shell would be required to accept inputs from various users and would, therefore, have to be able to recognize inputs form a variety of personnel under severely degraded conditions. Due to the variety of currently available command and control systems, this tool should be generic enough so that it could, with minimal effort, easily replace and I/O device for current applications.

PHASE I: Result in the initial development of the UNIX shell and a demonstration in which a user verbally communicates with specific command and control application on the system.

PHASE II: Extend the result of Phase I to accomplish the generic capability requirement to accept inputs from a variety of multiple users under severely degraded conditions, and demonstrate that it can reliably replace and I/O device for current command and control applications.

A90-025 TITLE: Innovative Techniques for Overcoming Co channel Interference in HF Modems

OBJECTIVE: To develop a techniques for single-antenna HF reception which can be incorporated as part of the demodulator to significantly improve signal reception in the presence of co-channel interference.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: HF radio waves often propagate long distance by ionospheric reflection, while channel allocations are severely limited by the available spectrum and MUF. As a result, HF radio reception is often disrupted by multiple transmissions, which originate over a side geographic region by which occupy the same frequency channel. It would be desirable to be able to demodulate and recover the information contained in the desired signal in the presence of such co channel interference. While adaptive antenna array techniques can be useful signal in the presence of such co channel interferences arrive from widely different directions, the receiver complexity and difficulty of deployment makes this solution impractical in many applications.

PHASE I: To evaluate and analyze innovative processing approaches to achieve the overall objectives stated above

PHASE II: To provide implement and laboratory and/or field demonstration of a full operating feasibility model.

PHASE III: As stated in overall objective above.

A90-026 TITLE: Artificial Intelligence for Command and Control

OBJECTIVE: Develop and artificial intelligence based decision aid for evaluation by Regular Army personnel in a realistic command and control tested.

CATEGORY: Advanced Development

DESCRIPTION:

GENERAL: A successful proposal must contain both detailed description of the technologies on which the potential decision aid is based; and the specific Army application it is intended to serve. Examples include, but are not limited to, the following:

A seamlessly integrated geographic information system and knowledge base. Such a system could be designed for one of these applications: determining and evaluation possible avenues of approach, defining optimal positions for artillery emplacement, assisting in the development of combat engineering barrier plans, properly

situating signal centers, determining the best lines of communications for logistics support, structuring the best air defense network, or efficiently placing sensor systems.

An object oriented tactical simulator with automatic reasoning capabilities. The knowledge base for such a simulator should be populated with relevant information on Red and Blue tactics, equipment, order of battle terrain constraints, etc. Such a simulator should be designed for realistic war-gaming by G-3 staff officers.

As cooperative problem solving environment for command and contort in a dispersed command post. Such a system must facilitate the formulation of plans and distribution of orders based on the combined requirements of maneuver, logistics, fire support, air defense, and intelligence units. Inputs and constraints from both higher and lower echelon units must be accounted for and properly prioritized. Methods for ensuing security, accountability, and retention of command authority must be considered.

Pattern recognition techniques applied to: terrain analysis (geometric computing); planning (plan monitoring and explanation); or image processing (intelligent image analysis). Application includes sensor interpretation for G-2 staff, tactical plan assessment, and rank ordering of messages entering signal centers.

PHASE I: Prepare a report describing the decision aid that can be built; the theories and technologies on which it is based; and the Army environment for which it is targeted. The report must reference a complex bibliography of relevant technical literature and contain a glossary. Objectives, plan, and required resources for the Phase II effort should be clearly specified in detail. Monthly progress reports are required. Delivery of software that illustrates a subset of the nominal system's functionality is desirable but not mandatory.

PHASE II: The specification, implementation, and evaluation of the decision aid defined in Phase I. Specification will be in accordance with a tailored version of DOD-STD-2167A. Implementation will be supported by commercial hardware and software platforms to the maximum extent feasible. Evaluation will be by Regular Army personnel in structured classroom or garrison environments. Evaluations may also be conducted in conjunction with Army command and control test beds.

PHASE III: Extension, enhancement, and modification of the decision aid implemented in Phase II. The resulting system should be robust enough for inclusion in an Army Program Manager. Documentation should be to a standard acceptable to an Army Program Manger.

A90-027 TITLE: Multi Sensor Automatic Template Generator

OBJETIVE: To develop the theory, algorithms and software to create templates for the in deification of the source of data. The templates are to be used to perform template-matching operations for the recognition of patterns in data of unknown source.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Patten recognition techniques have been used in the development of algorithms to identify the source of data available from different sensors. Among these, template matching has a strong appeal because it is easily understood and implemented. The effort ultimately will provide an algorithm and source code to create templates form extensive amounts of available sensor data.

Phase I of the effort should provide a survey of the available literature, an devaluation of the performance of the techniques already available, further theoretical development if required to maximize "performance" for the type of sensor used and a comparative evaluation of all the potential techniques being contemplated.

Phase II of the effort provide preliminary coding of at least two of the potential template creation techniques. Data will be made available and the performance of each of the techniques will be evaluated using some previously defined Measures of effectiveness (MOE's).

PHASE I: Will ultimately identify at least two possible techniques (including new ones developed under this portion of the effort) which are optimal in some predetermined set of parameters.

PHASE III: the effort will concentrate in the coding of the selected technique to make it as efficient as possible and to reduce user interaction. The technique will be loaded in a Government computer facility and Government representatives will be trained on its usage and theory. The technique will be tested at the Government facility and Government will perform representatives and modifications by the contractor as required.

A90-028 TITLE: Modulation Based Pulse Association Techniques

OBJECTIVE: Develop a means to accurately associated each pulse received by the front end of the Electronic Support Measures, ESM, receiver with the non-communication emitter that produced the pulse.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Modem ESM systems characterize each received pulse in terms of parameters such as frequency, angle-of-arrival, time-of-arrival, pulse width, etc. Which are then expressed in digital form and input to a specialized computer for sorting. Modern emitters utilize several techniques to try to thwart current pulse association techniques and thus lower their probability of intercept. Some of these techniques are frequency agility, chirp, chip, jitter, etc. However virtually every emitter impresses some form unintentional modulation pulse, UMOP, (e.g., leading edge overshoot, trailing edge rate of decay, etc.).

What is desired is a means to compare all pulse received (200,00 worst case) over some short (e.g., 100 msec) dwell with a "catalog" of the previously received pulses (100 different, independent emitters worst case) to output a "best match" digital output (e.g., the current pulse is most like the 8^{th} different type of pulse received) concurrently with the parametric of the current pulse. It should be assumed that a wideband (500 MHz wide) If is provided as input along with strobe(s) signaling the start of pulse. Notes: pulses may overlap in time (i.e., a different frequency pulse is received before the first pulse has ended), all emitters will not necessarily transmit each dwell, and the UMOP parametric need not be explicitly measured and reported

PHASE I: Develop the specification for and analytically predict the performance of the proposed approach as it could be implemented in as ESM receiver.

PHASE II: Demonstrate the performance of the proposed approach by building a prototype and interfacing it to the ELINT/ESM Test bed (i.e., MEDFLI).

PHASE III: Build a unit to interface with the growth slot in SILENT FOX (a joint US-Canadian ESM payload for the Unmanned Aerial Vehicle (UAV)) which will become a preplanned product improvement. Apply the technology developed to the nest generation ELINT/ESM receiver.

A90-029 TITLE: Fiber Optic Remote Antenna System

OBJECTIVE: Develop an antenna system that can be deployed remotely from the ground-based radar and/or jammer site.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Currently, all antennas are collocated with radar and jammer systems which operate at the microwave frequencies; this deeps the coaxial line transmission attenuation and electromagnetic radiation to a minimum. However, this limits the effective secure operational range and control of the radar and jammer systems. As a result, the antennas cannot be placed at a remote site due to high electromagnetic radiation and high coaxial transmission attenuation at the microwave frequencies.

What is desired is an antenna, which can be remote using fiber optic links to transmit the RF energy between the radar/jammer and the antenna. The goal here is to minimize the weight/power consumption of the remote antenna, via the use of RF/optical conversion.

PHASE I: Show the feasibility of fiber optic remote antenna, develop the specifications, and propose an approach to develop the actual fiber optic remote antenna system.

PHASE II: Implement proposed approach, and demonstrate the potential of the fiber optic remote antenna system.

PHASE III: Implement approach in tri-service wide application.

A90-030 TITLE: Distributed Ada Real-Time Software: Development and Execution Support

OBJECTIVE: The objective of this project is to provide support for the development of distributed Ada real-time software for loosely coupled homogenous microprocessors. This will include addressing the issue of an Ada compilation system and a distributed runtime environment that will effect the distribution of a program through an integrated process without manual modification of code.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: In order to obtain the performance needed for Ada hard real-time embedded software systems it is often necessary to distribute a program so it runs on an network of loosely coupled microprocessors. The Ada language provides a tasking model that can be used as a single model concurrency if distributed rendezvous can be supported across multiple processors. There is currently no simple method defined to accomplish the development, testing, and execution of distributed Ada programs. Software developed for distributed systems often involves manual preprocessing of source code or post processing of object code in order to direct the distribution. There are no provisions for, among other things, dynamic task migration between processor, transparent network debugging support with synchronous halting of all processors and system clocks, analysis of behavior that could predict overload conditions, analysis of tradeoffs involved when network interface standards are imposed that affect real-time response requirements, allowing for standard fault tolerance techniques, and testing that time requirements are being met any the software running on multiple processors. Distribution support is needed from an integrated compiler/linker/tester environment with 2 distributed runtime in order to realize the benefits of using the Ada model of concurrently as a uniform model among multiple processors.

The results of phase I will include an analysis of the current state-of-the-art in development of distributed real-time Ada systems, specifically in the tools to support distributed development and execution. It will propose a solution that will answer as a minimum the issues described I this distributed Ada runtime environment concept that will demonstrate the viability of the approach to accomplish the distribution of an Ada program.

Phase II will implement the proposed prototypes that will support the implementation, testing, and execution of distributed Ada software.

PHASE I: Research will be completed exploring issues and concepts and prototype solutions will be proposed.

PHASE II: Proposed prototype will be developed.

PHASE III: Proposed product will be developed.

A90-031 TITLE: Requirements Engineering Methodology and Techniques

OBJECTIVE: The object of this research is to develop or to integrate methodologies, techniques, or tools for the development, validation, verification, and maintenance (tracking, linkage, change management, etc.) of requirements for Army systems as they relate to computer software.

CATEGORY: Engineering Development

DESCRIPTION:

GENERAL: Effective development and management of system and software requirements have a great impact on the life cycle cost. Technologies such as Computer Aided Software/System Engineering (CASE), Artificial Intelligence (AI), Reverse engineering, interactive design techniques, and rapid prototyping need to be advanced to provide support for Army software under specification, development or maintenance.

The following is a partial list of relevant sub topics: The requirements development process: Definition of requirements, modeling the requirements process, supporting concept exploration, determining requirements functionality and feasibility, requirements analysis and validation, managing requirements changes throughout the life cycle, requirements documentation, accommodating changing user needs and perception, and handling changing threats. Requirements engineering tools and techniques: How should/can requirements engineering automated, languages and techniques, semantic analysis, information/decision capture and re-use, expressing concurrency and timing, and standards to provide compatibility between tools. Prototyping: Specification animation, executable specifications, and user interface. Battlefield and Army doctrine modeling with CASE technology.

Proposals should describe the applicability of the research to specific Army systems.

PHASE I: Phase I products would be reports establishing proof of concept and describing the approach and procedures to be used in Phase II.

PHASE II: Phase II products would involve demonstration of methodologies, techniques, or tools together with documentary reports which fully describe recommendations for incorporating these advancements into the system life cycle.

PHASE III: Phase III efforts would be the incorporation of the advanced technology into actual Army systems, as well as the commercial production of software that supports requirements engineering.

A90-032 TITLE: Software Reuse Technologies & Tools

OBJECTIVE: To develop Software Reuse Technology and Tools that will aid in the Reuse Process

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Software has become the major cost of Army C3J systems currently in the field or in development. The mandate for the use of Ada offers the opportunity for reusing major pieces of previously developed software in the development of these systems. The lack of experience with Reuse and Ada, coupled with the increasing complexity of the systems being developed, has resulted in technical barriers to Reuse

The objectives for this research topic are to develop the technology and tools to support the processes of generating and reusing Ada packages and components. Proposed tools for this topic should support reuse in one of two categories as follows:

DOMIAN SPECIFIC: The domain is partitioned by way of a thorough analysis, which defines all of the reusable parts. Parts are categorized and stored in a domain specific library. A limited number of the parts may be applicable in other domains. This concept can be extended to what has been called a Generic Architecture (GA). In the GA, the design and components are reusable from one application to another. Artificial Intelligence techniques could be useful in the implementation of domain specific knowledge.
DOMAIN INDEPENDENT: Software modules/parts are designed for reuse in multiple domains. The modules/parts are analyzed with Reusability Metrics t determines there potential for inclusion in a general-purpose software library. The library system requires a method for categorizing the parts and identifying the characteristics, which will be keyed on the retrieval system. Storage and retrieval can be manual, semi automated of fully automated.

Use of the DOD standard language, Ada, is a requirement for this research topic. Proposed tools should be described in terms of how they support the reuse process and whether they are limited to the domain specific case or not.

PHASE I: This phase should be a concept validation phase. The output is expected to be a report along with some demonstration software. The software does not have to deliverable. The report and demonstration should illustrate the viability of the approach

PHASE II: This phase should develop a prototype version of the software tool. The software from phase II should be delivered for evaluation purposes. After a Government evaluation phase is completed, it is anticipated that the ARMY, which will make the production version amour useful product, will generate some recommendations.

PHASE III: This phase will take the prototype along with recommendations form CECOM and develop a production quality Software Reuse Tool.

A90-033 TITLE: Electronic Warfare HF Antenna Size Reduction

OBJECTIVE: The objective shall be to determine whether new emerging technologies and materials in the areas of superconductivity research and/or dielectric material research can be applied to HF antenna designs. The goal shall be to determine if the physical size currently associated with available tactical HF antennas can be reduced without degrading currently accepted performance.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: The purpose of this research shall be to investigate possible methods and/or technologies relating to superconductivity and/or dielectric materials for reducing the physical size HF (1.5 to 30 MHz) jamming and intercept antennas. In a tactical environment where long setup times and camouflage of large antennas are impractical, the development of smaller HF antennas would have a significant tactical and operation impact. The intent of this program shall be to create smaller antennas without sacrificing gain, frequency or power handling capabilities. Design should be flexible enough for use on a variety of carriers from tracked vehicles to drones.

PHASE I: This phase shall investigate superconductivity and/or dielectric material technologies/techniques and materials for reducing the physical size of HF antennas. A tradeoff analysis is performed based on frequency bandwidth, directivity, gain weight, volume and cost. The critical design parameters are size and gain.

The tradeoff results shall be used to recommend the approach(s) that appear to offer the best realization of smaller but efficient HF antennas. A proposed design of the antenna along with calculated and or simulated performance data shall be submitted along with results of the tradeoffs in a Phase I report.

PHASE II: This phase shall consist of fabricating, testing, and evaluating the proposed design. Performance characteristics hall be measured, recorded, and analyzed. The contractor shall be expected to make design modifications during the testing phase to try to optimize the performance as much as possible. Phase II shall conclude with the delivery of a prototype antenna and a Phase II finial report.

A90-034 TITLE: High Power Density Transmitter Cooling Device

OBJECTIVE: Improvements of more than an order of magnitude are required in the methods and materials used for heat dissipation in high power density semiconductor transmitters so that the power devices can use their full rating can operate with ambient air-cooling, and the junction temperature is kept at reasonable values for reliability.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Semi conductive devices are dominating high power density broadband applications such as ECM transmitters and communications transmitters. During the past few years the transistors have increased in capability where, in order to use their full CW rating, dissipation of 400-1400 watts per device is mandatory. Other circuit elements, such as ferrite-loaded inductors used are HF/VHF impedance transformers, capacitors, and switches in harmonic filters are also required to be cooled by water-cooled heat sinks. This immediately limits that application of high transmitter powers to large vehicles, which can carry the heat sink weight (which is eight or more times the circuit component weight) and the coolant, coolant pumps and radiator weight. The heat sinks are also very large compared to the devices and circuits that they are cooling.

The thermal packaging design is to maximize device power handling capability, be productive, reduce weight and volume of the supporting cooling system, preferably ambient air, and increase reliability by reducing junction temperatures of the transistor, particularly under typical CW and 2:1 VSWR operations. Previous efforts have used copper in place of aluminum as the heat sink, liquid cooling of the top of the die or other component, and very large heat pipes. Copper as the basic heat sinks its too heavy. The liquid cooling of the die, while successful in some applications, adds the coolant weight, the weight of the second coolant container die, while successful in some applications, and the coolant weight, the weight of the second coolant container on the circuit card and potential orientation problems if the coolant is not deep enough to cover the die continuously. When ferrite components are to be cooled, then this second coolant container becomes very large. Large heat pipes in the heat sink have increased, not decreased the size of the heat sink.

The use of micro-heat pipes or a flat heat pipe with laminar flow embedded into the heat sink has a potential of three to four orders of magnitude better heat conductivity than aluminum. There are other potential cooling approaches such as thermoelectric devices coupled to a heat sink or combination of approaches. The heat pipe can be part of the transistor package.

PHASE I: Investigate, analyze, compare using thermal models of possible micro-heat pipe and other advanced cooling approaches for high power density transistors and circuit components. Conducts. Conduct tests on cooling capability of best approaches

PHASE II: Develop best cooling approaches into prototype models. Demonstrate on a typical 140 OW output CW operating push-pull amplifier of two transistors and ferrite loaded coupling transformer. The devices will be dissipating 100 OW each and the junction temperature should be held to 167-172 C using 62 C ambient air. Efficient circuit design is not part of this topic

PHASE III: Convert the prototype design into a producible, modular component.

A90-035 TITLE: Directive Radiating Expendable Jammer

OBJECTIVE: The objective of this research is to improve the jamming effectiveness of small expendable jammer systems by providing the capability to directivity radiate their jamming signal. The technical challenge will be to engineer and design such as system that is of a physically small enough configuration to be part of expendable jammer design.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Current expendable or remotely emplaced jammer systems in development plan on using a single radiating element to transmit their jamming energy in an omni directional pattern. Assuming that theses expendable systems are placed in targeted location where some intelligence information about enemy tactical disposition, avenues of movement, etc. are know, this omni directional radiation does not effectively utilize the time limited jamming energy resources efficiently nor does it maximize its potential jamming effectiveness by concentrating this energy in a given direction. This project will investigate whether there is a viable technology available to increase expendable jammer effectiveness by incorporating directive transmission techniques into expendable jammer designs.

PHASE I: This phase will investigate the feasibility of introducing a directional radiating capability into a generic expendable jammer system design. Various techniques to beam steer or directivity radiate shall be considered. Trade-off analyses and consideration shall be given to design factors for operation in the VHF and low UHF frequency range, achievements or not required power, and some methodology to set the direction instruction message. Analysis will be conducted on whether jammer self-orientation knowledge would be required, i.e. whether the jammer will need to recognize North-South, East-West direction through its own capability in order to properly reference the correct direction commanded to radiate in.

The result of Phase I will be a conclusive feasibility analysis of providing a directive radiating capability into an expendable hammer configuration. The analysis will contain supported engineering estimates of critical design factors such as size, weight, power consumption, radiation effectiveness/efficiency, and directivity control/self-orientation schemes. The various directivity techniques considered will be analyzed and compared. A most feasible approach will recommend.

PHASE II: This phase will require the contractor to design, fabricate, test, and evaluate a laboratory/prototype-working model of the Phase I recommended approach. Standard laboratory test equipment shall be used to generate the expendable jammer exciter/transmitter signal to the input of the directive radiator subsystem. This subsystem shall be capable of accepting a maximum 10 watts continuous wave input from 30 to 500 MHz. This design should show achieving the frequency range, any tuning time, and efficiency comparable with current expandable jammer designs. The scheme recommended as most feasible to control directivity shall be demonstrated.

A90-036 TITLE: Analysis and Evaluation of Advanced Direction Finding (DF) Approaches

OBJECTIVE: Provide inexpensive, user friendly, menu driven, evaluation and developmental DF engineering workstation and algorithms to verify that optimal direction finking solutions are provided to the US Army for tactical Direction Finding (DF) systems with the emphasis on SKYWAVE and single site location. The suite of tools will be used in field tests and for the laboratory modeling and simulation of ionosphere propagation phenomena and DF algorithms and to verify contractors' proposals of advanced DF technologies.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: The Army is unable to properly evaluate major DF system proposals because the simulation modeling and verification equipment and algorithms needed would typically be as expensive as the systems proposed. The physical limitations and bounds of achievable accuracies possible in HF DF are unknown. This is particularly true of SKYWAVE and especially for the near vertical incidence skywave (NVIS) aspects of the problem. The Army needs an inexpensive laboratory test bed configuration to evaluate and verify emerging techniques using modeling and simulation to evaluate proposed system approaches from contractors. In addition, this systematic capability would be used on a nearly constant basis for US Army researchers doing internal RDT&E in these fields. This broad requirement will require a very flexible system.

PHASE I: Incorporate reduced instruction set computers (RISC) and digital signal processing (DSP) ships into a modular, user friendly configuration with menu driven software to facilitate verification and testing of emerging DF concepts.

The suite of hardware must run propagation and ionospheric program models like METHODS AND MOMENTS, NEC, IONCAP and ADVANCED PROPHET in conjunction with the concepts under investigation, as appropriate. In addition to considerable scalar and vector processing requirements, the suite must include receivers, analog to digital converters, ionosondes, antennas and related hardware to provide actual test data in addition to the simulation and modeling approaches mentioned above.

Government furnished equipment will be incorporated, within reason, to keep cost down. The Phase I deliverable will be a "scientific engineering workstation" with appropriate software to support research and development, test and evaluation of new DF approaches and to aid in evaluating systems approaches proposed by contractors.

PHASE II: Test tactical DF systems to ascertain the degree to which they conform to stated contractual capabilities requirements. Model and simulate the existing and proposed Army DF systems and provide P3I recommendations to improve these existing and emerging Army DF systems. Establish a library of callable functions to include ionospheric calculations. Provide a means of processing near real-time data from multiple receivers with correlated ionosonde information.

PHASE III: The goal for Phase III is to amalgamate the best of the best ideas to serve as the foundation for a new generation of US Army tactical DF and location systems dupable of exploiting threats through the year 2020. Phase III will incorporate the best features of concepts developed by contractors, academia and US government researchers into a compact DF proof of principle 6.3A system. This system would be used to conduct field tests in a variety of conditions. This system would be the nucleus for the next generation of US Army Tactical DF Systems.

The library of callable functions developed in Phase II would continue to evolve to include capabilities to exploit emerging transmission schemes and use improved ionospheric calculations. The Phase III system would processes the data in real-in-time data from multiple antennas and receivers with correlated ionosonde information.

A90-037 TITLE: Assumption Truth Maintenance System in Automatic Target Recognition ATR Algorithm Design

OBJECTIVE: The design of a truth maintenance system for dependency tracking and belief revision in automatic target recognition systems.

CATEGORY: Advanced Development

DESCRIPTION:

GENERAL: In a given approach to ATR algorithm design, an underlying of assumptions provides computational and conceptual efficiency. This network includes concrete assumptions about the physical

characteristics of the real world scene and abstract assumptions about knowledge acquisition and characteristics of the real world scene and abstract assumptions about knowledge acquisition and representation. A facility for the identification and tracking of assumptions in dynamic systems is critical for performance evaluation purposes. The intersection of the assumptions at a designated stage of the target recognition process defines the valid domain of application of the ATR system.

The investigation of truth maintenance for hierarchical reasoning with constraints is an active area of research in the artificial intelligence community. The intent of the proposed research is to develop an approach to assumption truth maintenance for application to complex, visual pattern recognition systems. The type of assumptions made in automatic target recognition systems will be systematically identified, from the low-level pixel domain to he high-level mission statement. This approach will permit the reaching of algorithm assumptions as they propagate through the pattern recognition process and provide for belief formulation and revision to maintain consistency. The automatic target recognition system will employ rule-based, hypothesis generation and test, or other reasoning paradigms conductive to model-base algorithm development. A prototype set of infrared test imagery at varying levels of resolution and signal-to-noise ratio, representative of the given problem domain, will be made available to the contractor.

PHASE I: Present one or more truth maintenance methodologies applicable to the target recognition task scenario.

PHASE II: Develop, implement, and demonstrate a selected truth maintenance system for a limited problem domain.

PHASE III: Expand the methodology for demonstrated applicability to more generalized visual pattern recognition problem domain. Formulate specifications for a build able truth maintenance module to integrate into a large-scale ATR system design.

A90-038 TITLE: Solid-State Laser Materials Development for Efficient Emission of Radiation in the Visible to Infrared Bands

OBJECTIVE: New and efficient laser materials are sought for improved efficiency and lower cost of laser sources. This contractual effort is for the envelopment of the materials only, and not of the actual laser device. This program will permit the growth of new, low cost and efficient solid-state laser materials on a quick turnaround basis.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Laser materials for efficient, tunable of discrete generation of laser wavelengths are sought that can be grown and evaluated on a fast turnaround basis between a proposed composition and growth on one hand, and materials evaluation and information feedback on the other, so that other composition of host/dopant combinations can be synthesized and tried for successful growth. Non-linear materials in support of this program, as well as multipoint cascade or so-called two-of-one or multiphoton generation schemes could be acceptable as well. Organic crystal fabrication could be included if the crystal has a sufficiently wide transparency wavelength range.

PHASE I: Demonstrate feasibility of growing small crystals of selected composition that will show promise of effectively increasing efficiency and lowering production costs.

PHASE II: Increase the scale of crystal fabrication for Industrial as well as for Government test and evaluation.

PHASE III: Produce commercially those crystals that show a drastic improvement in material efficiency.

A90-039 TITLE: In Vacuum Processing of Infrared Detector Arrays

OBJECTIVE: To develop a high-yield low-cost processing technology for infrared detectors

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: When traditional semiconductor processing techniques are used to fabricate infrared detectors arrays, the yield is low and the array cost is high. To address this problem, novel processing schemes have recently been proposed by CCNVEO scientists. These schemes involve (1) growth of detector layers in a vacuum environment by the new technique of molecular beam epitaxy (MBE), and (2) formation of arrays on theses layers without removing them from the ultra-clean MBE environment. In FY89, CCNVEO has made a major equipment investment to show feasibility of (1). To implement the entire processing scheme, techniques for accomplishing (2) must be developed.

In Phase I, feasibility studies will be conducted aimed at developing novel techniques for transforming epitaxial layers of mercury cadmium telluride into infrared detector arrays. These techniques must be fully compatible with the high vacuum environment of an MBE chamber.

In Phase II, the lowest risk processes will be optimized and tested. Testing will be accomplished by constructing vacuum processing modules, delivering them to CCNVEO, coupling them to the new CCNEO MBE chamber and demonstrating feasibility of the substrate-in array-out concept.

PHASE I: Proposed and show feasibility of new concepts for fabrication infrared detector arrays in a high vacuum environment.

PHASE II: Optimize in vacuum processing techniques and demonstrate feasibility of substrate-in array-out concept.

PHASE III: commercialize the process and equipment for high-yield low-cost infrared focal plane arrays.

A90-040 TITLE: Integrated Audio-Video Headset Display Terminal for Maintenance Personnel

OBJECTIVE: To develop an integrated lightweight audio-visual headset display terminal with a miniature swivel mounted color monitor, remote I/O receive/transmit capability, and a voice command access, response and control system. The IAVHDT will provide maintenance personnel with the ability to access, view and manipulate the information being displayed by bench top PC- based ADP/TMDE equipment CRT terminals remotely at distances of up to 100 feet from the work bent, and to provide verbal input of information in lies of keyboard entry.

CATEGORY: Exploratory Development

DESCRIPTION:

GERNERAL: Recent advances in the state-of-the-art of electronic speech synthesis, speech recognition and display technologies can now support development of a new generation of user wearable display terminals which can functionally replace the cumbersome keyboards and CRT display monitors of desktop and bench top PC based ADP equipment. This will allow maintenance and repair personnel to effect troubleshooting diagnostic and repair activities more easily by remotely bringing the ADP based capabilities to the work/repair site rather than taking the failed equipment to the ADP site. This will also provide maintenance personnel with new capabilities to work in awkward or contorted body positions, confined spaces and locations, or out of the visual/physical range of convectional CRT monitors/keyboards.

The IAVHDT should be designed as a two-piece system consisting of the user wearable headset and a base station. The headset consists of microphone, an earphone, a color monitor capable of high-resolution graphics and 25 line 80 column text display. The headset should be lightweight, ruggedized battery powered, and capable of remotely operating up to 100 feet form the base station. The base station unit should contain all necessary hardware and the system operating system. The base station should interface to existing or planned diagnostic systems, PC based equipments, computer based technical documentation systems, Knowledge Based Expert Systems and be connectable to telephone networks for accessing remote facilities. A calculator style keypad and/or test probe should also be capable of being connected to the headset when voice response would become impractical as the particular repair situation/user application dictates. The normal mode of user access/control shall be through voice commands and responses.

PHASE I: Conduct a feasibility study to examine the feasibility of alternative concepts, ideas, technologies and products which could be utilized to develop a system solution with the desired capabilities. The study should address currently available off-the-shelf product/components, system cost and cost-effectiveness, technical planned and existing Army logistic and maintenance systems. The study shall also recommend one or more system hardware/software solution approaches and describes several applications of how to proposed solutions could be used in the maintenance of Communication-Electronics. Systems and equipments to demonstrate feasibility.

PHASE II: Design, develop, fabricate and conduct test and evaluation activities on a prototype demonstration system to demonstrate system feasibility, cost effectiveness and utility/worthiness.

PHASE III: Produce commercially available off-the-staff production hardware/software and applications packages.

A90-041 TITLE: Process Improvement Tool for Software Development

OBJECTIVE: To improve the effectiveness of detecting and analyzing errors during software development so that the feedback can be used to improve the software development process. In other words the objective is to improve the detailed technical mechanism of Total Quality Management in the area of software.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: During the development of maintenance of large software intensive C31 Systems it is a well-known fact that the earlier problems are detected the less expensive they are to fix. Important techniques for early detection of software errors/defects are Software Quality Assurance (SQA) Audits, structured design and code walkthroughs and units tests. The importance of using these techniques in a systematic and effective way is emphasized by the following key questions in the DOD software Engineering Institute's Method for Assessing the Software Engineering Capability of Contractors (Sept. 87)

Is a mechanism used for verifying that the samples examined by SQA are truly representative of the work performed?

Are the review data gathered during design reviews analyzed?

Is the error data from code reviews and tests analyzed to determine likely distribution and characteristics of the errors remaining in the product?

Is review efficiency analyzed for each product?

Are analyses of errors conducted to determine their related causes?

The focus of the SBIR topic is to explore the feasibility of an advanced computer-based tool that will significantly enhance government or contractor capability for control of the software development process including also control of the quality, validation and verification checks which are normally performed as part of the detailed design phase, coding phase and unit test phase. The optimum types of inputs tot eh tool should be identified during Phase I. The inputs would include information such as defect/error data from manually provided discrepancy reports and from RDL and code analyzers, quantitative data from quality assurance reviews, and design/cod walkthroughs, and data from the review of unit testing. Other relevant information such as system characteristics and software development methodology might also be input. Phase II would involve development of the tool itself for a limited range of applications. The emphasis for the tool is in near real-time feedback into the software evaluation process, which would improve the overall software development process.

PHASE I: The objective for phase I is to define a set of software fault tolerance enhancement techniques and determine the feasibility and extent of automated assistance for implementing these techniques on actual tactical Ada software.

PHASE II: The phase II objective will be to implement a prototype tool that will support the performance of the techniques defined in phase I and refined in phase II. The recommended software techniques and prototype tool would be demonstrated in a small “pilot” software development effort and analysis will be performed on the resulting software product test data.

PHASE III: The objective of phase III is to commercialize, distributes, and refines the tool and techniques for general application.

A90-042 TITLE: Testing of Military Production Hardware

OBJECTIVE: To determine the optimal levels of hardware testing at each level of assembly to maximize end item reliability and minimize total costs.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: Current military procurement contracts invoke military standards which require extensive testing of components, subassemblies, assemblies, and end items. The combined efforts of this testing may induce latent defects of reduced life expectancy of military equipment/systems. This study should determine the accumulated effects of imposed environmental and electrical stress occurring during the manufacturing test sequence from component to final end item acceptance for the purpose of determining the detrimental effects of such testing.

PHASE I: Determine the impact environment and electrical stressing has on a CECOM item which has just come off the production line but has not been fielded and report the finding of this investigation to the government. The method used to conduct your investigation should be documented to the extend the allows other who may conduct such an investigation to arrive at similar findings.

PHASE II: If the results of phase I indicate that environmental and electrical test currently being employed by CECOM have a detrimental effect on the reliability of an equipment/system the contractor should provide an alternative and improved mythology for measuring reliability without adversely affecting the reliability newly produced items. This mythology should be implemented on a prototype and a detail report of finding provided to the government which underscores the results of the new stress (test) procedures.

PHASE III. Proving phase II revised stress/test procedures are in accordance with best environmental and electrical testing practices, provide guidance documentation for use by the technical community which explain in detail how to implement the new stress/test guidelines for communication equipment.

A90-043 TITLE: Improved Software Fault Tolerance Techniques

OBJECTIVE: To develop and facilitate implementation of techniques to improve the software fault tolerance attributes of tactical real-time Ada computer programs.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: The reliability and availability of tactical system software are critical to the soldier in the field. Significant progress has been made in reducing the number of software faults/failures through improved quality assurance, testing and software reliability measurement techniques. However progress in improving tolerance to and recovery from software faults (a factor affecting availability to the user) has not had as much impact. Exception handling is part of the Ada Language; however implementation of this feature in software has been less than systematic. The use of multiple program versions for redundancy is only practical in the most critical applications (i.e., space vehicles). Research effort is needed to identify practical techniques that can be applied to requirements, design and coding which will localize the effects of software faults and reduce the time necessary to recover. The concept of software fault tolerance can be broadened to include all software features which can be used to reduce system downtime and maintain continuity of operations when software errors occur. Tactical system software requirements are normally stated in the positive sense, in terms of what the final product should do for the user. It is difficult to specify requirements for how the software should perform in the case where there may be undiscovered errors in the software. Software developers are reluctant to assume failure. What is needed is an approach to software development which will build in software fault tolerance.

PHASE I: The objective for phase I is to define a set of software fault tolerance enhancement techniques and determine the feasibility and extent of automated assistance for implementing these techniques on actual tactical Ada software.

PHASE II: The phase II objective will be to implement a prototype tool that will support the performance of the techniques defined in phase I and redefined in phase II. The recommended software techniques and prototype tool would be demonstrated in a small “pilot” software development effort and analysis will be performed on the resulting software product test case.

PHASE III. The objective of phase III is to commercialize, distribute, and refine the tool and techniques for general application.

A90-044 TITLE: Capturing Analog Design for Technology Update

OBJECTIVE: To investigate and implement techniques for minimizing the impact of obsolete analog parts on the readiness of military communication-electronic equipment

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: Military systems become obsolete due to the inability of the government to procure critical component for the support of field equipment. For digital components VHSIC Hardware Description Language (VHDL) has helped to solve these problems by capturing the functional requirements. A similar approach may help solve this problem for analog parts, which in turn will keep field equipment operating.

PHASE I: Conduct a feasibility study to determine whether or not the functional requirements for analog circuit can be captured on a description language such as VHSIC Hardware Description language (VHDL).

PHASE II: Target a CECOM equipment/system using analog circuitry and capture the functional design in hardware description language and provide a prototype example using this new technology which does not change the fit form of function of the original equipment/system. Test and report findings regarding the function of the prototype to the government for evaluation.

PHASE III. With the successful completion of Phase II identify fielded CECOM items that have a field life expectancy of seven years or more and prepare a Request For Proposal that would allow for the redesign and manufacture of this equipment. All rights, documentation, products etc. created as a result of this research effort is deliverable to the government prior to beginning Phase III of the project.

Chemical RDE Center

A90-045 TITLE: Development of a Device for Sorting Micron Size Dielectric and Conducting Powders

OBJECTIVE: Develop a device to sort quantities of micron size dielectric and conduction powers, such as pigments, based on particle size and shape.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Pigments and other powder each contain a distribution of particle size and shapes. Commercial methods of centrifugal air classifying particles are suitable for separating small aerodynamic size from large aerodynamic size. An additional separation mechanism besides centrifugation, such as electrostatic surface charging followed by separation on an external electric field is suggested to separate based on both size and shape. This is important to the U.S. Army smoke program because performance of powders as aerosols shape.

PHASE I: A small prototype device will be constructed, perhaps using commercially available components. The Army will supply twenty samples of powder to be separated and returned to the Army for testing along with a description of the device and an analysis describing the physical working principles.

PHASE II: Large device will be constructed, tested and delivered to the Army. Twenty samples will be provided by the Army, for testing. The device will be capable of sorting greater than ten-pound quantities of the powders within an hour and with no more than one operator in attendance. Preferably, the device will continue to operate unattended on started.

A90-046 TITLE: Single Particle Multianalysis Chamber

OBJECTIVE: Construct a pilot device to sample micron-sized particles from the atmosphere and inject single particles into an elector dynamic suspension device for analyzing the same particle by several different methods including light scattering and various spectroscopes. The device must be capable of moving particles from one chamber to another for different types of experiments and adding chemical as needed for analyzing the particle.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: In recent years the use of various types of suspension chambers has led to the development of optical means of analyzing the content of particles including both solvents and soutes. The particles analyzed are in the one-micron to thirty-micron size range. The use of fluorescence, infrared, and Raman spectroscopy has been shown to allow analysis of the contents of liquid droplets in the size range. The use of optical resonance in the mile scattering can enhance the sensitivity of these spectroscopic techniques and provide high-resolution volumetric analysis. Electrodynamic suspension in the chamber can provide gravimetric analysis. A

device is needed where several of the above methodologies can be performed sequentially on the same single micron-sized particle. It is desirable to develop means of sequentially moving single particles non-destructively from one chamber to another so that after the first type of optical analysis, a second type of experiment may be performed on the same particle including adding various test chemicals also in micron-sized amounts to identify the contents of the original particle. These tests should be capable of being performed at temperature controllable to +/-0.1 degrees Celsius at know pressure, in controlled humidity and with known atmospheres of surrounding gases. Further one should be able to automatically monitor changes in mass of the unknown particle as it absorbs gas, evaporates or has test chemical added to it. The means for adding carefully monitored micron-sized amounts of test chemical to a suspended particle must be provided and demonstrated. Finally, since it has been shown that mass spectrometry of the chemicals making up a single particle is of use in identifying the particles, the same particle should be able to be delivered for analysis in such a device after all the other tests have been carried out. One should alternatively have the option of saving the particle for microscopy.

PHASE I: Experiments to determine which of the above methodologies may be achieved in a single device as well as theoretical analyses to show which combination of methods yields the best information regarding the nature of an unknown particle studied.

PHASE II: Construction of a pilot model of a device utilizing several of the analysis methods. The methods to be included in the instrument will depend on the results of the Phase I experiments, but will include a minimum of the ability to move a single particle from one chamber to another, to add chemicals to a suspended single particle, and to utilize more than one type of spectroscopy on one single particle. All these features should be combined in a single instrument.

A90-047 TITLE: Atmospheric Pressure Ion-Molecule Chemistry in Ion Mobility Spectrometers for Increased Sensitivity and Specificity

OBJECTIVE: To developed specific gas ion-molecule chemistry in Ion Mobility Spectrometry (IMS) systems and to develop new IMS signal processing techniques to allow significant improvements of military systems and, therefore, application of such systems to the detection and monitoring of illicit/illegal drugs, chemical taggants in explosives, and hazardous industrial chemicals.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Military, hand-held systems are used for detecting chemical warfare substances, IMS systems can be useful in industry to monitor chemical storage sites for hazardous vapors. IMS systems have also been shown to be responsive to both heroine and cocaine as well as to chemicals used in the manufacture of these drugs and, therefore, applicable to the “War on Drugs”. IMS response to many compounds that have been proposed as taggants to allow detection of concealed explosives has been demonstrated too. Most detection interferences to the determination of the materials of interest.

PHASE I: Perform a background study of the state-of-the-art in specific materials that can be added to IMS systems to improve specificity by virtue of ion-molecule chemistry and in signal processing algorithms to allow interference rejection. Phase I would delineate chemistries and signal processing that will improve IMS detection of:

a. Illegal drugs (cocaine, heroine, etc. and their precursors)
b. Chemical taggants for commercial or military explosives
c. Industrial hazardous chemicals (solvents, cleaners, etc)

PHASE II: Quantitative and semi-quantitative studies of the ion-molecule reactions must be carried out and documented in an easy to use form. The peak selection, or compound identification, algorithms must be refined and tested in a variety of scenarios with respect to Phase I application above. “Add-on” hardware (e.g., heated

inlets, aerosol samplers, etc) identified in Phase I must be constructed and tested. Phase II would result in the provision of information and systems that can be used in a variety of military, environmental, and law enforcement applications where previously developed IMS systems are ineffective.

A90-048 TITLE: Vehicle Interior Decontamination System

OBJECTIVE: To demonstrate the technical feasibility of the development of a system to be used for the decontamination of combat vehicle interiors.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: There are no systems currently in the field or in development, which may be used to decontaminate the interiors of vehicles, vans, shelters, or other enclosed spaces. Traditional aqueous based systems are not applicable since the equipment usually cannot be sprayed with water solutions. Gas phase systems based upon the concept of fumigation, which are used for biological disinfection, have been investigated sporadically but have suffered either from a lack of reactivity or from the converse, an excessively reactive or corrosive nature. A concept for a system utilizing hot air to accelerate the evaporation of the agents was carried into development a few years ago but the effort was halted when it became apparent that the process would be too slow to be operationally feasible. To be acceptable the method must be rapid, efficient, non-destructive to electronic equipment, and capable of being carried on board the vehicle on which it is to be used. New concepts, which address these requirements, or modifications of previously attempted concepts, which eliminate earlier drawbacks cited above, are sought.

PHASE I: The objective of Phase I will be the initial feasibility demonstration that the concept proposed will be suitable and effective. Some experimentation to validate that the method will work but will not destroy equipment typical of that found on the interiors of tactical vehicles will be required.

PHASE II: Reduce the concept to the breadboard or working model stage. This effort will show that not only will the concept work in a controlled laboratory setting, a s demonstrated in Phase I, but it is likely that a larger scale could be developed which could be successfully fielded.

A90-049 TITLE: Detection of Large Molecular Weight Toxins

OBJECTIVE: The objective of this project is to develop a test kit which would be capable of detecting large molecular weight toxins from environmental samples.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: The M256 and M272 test kits are fielded item, which have the capability to detect classical chemical agents from the air, surfaces, or water sources. A product improvement effort is presently underway to expand the capability of these kits to detect small molecular weight toxins; however, there is no present effort with respect to large molecular weight toxins. Recent advances in areas of immunoassays and miniature instrumentation have made available simple, rapid capabilities to detect a variety of different substances with little or no skill on the part of the operator. Utilizing government furnished reagents, the contractor will develop a test kit for the detection of large molecular weight toxins. The technology need not necessarily be capable of identifying the toxin, but should be able to demonstrate that a hazard exists. The technology should be capable of interfacing directly with either of the kits above, and not compromise the performance of these kits with respect to shelf life or detection capabilities. The probability of success of this project is high Commercially available technology already exists in the clinical and home health-care marketplace. These products have undergone rigorous testing by the food and Drug Administration for safety and efficacy. The multitude of home

pregnancy test kits attest to this fact. It is only necessary to evaluate this technology for agents, which are of interest to the military.

PHASE I: Demonstrate the capability of the technology to detect up to three agents, using government-furnished reagents.

PHASE II: Demonstration of such characteristics as stability and interface capability with the presently available chemical agent test kits. Successful technologies could then be transitioned to advanced development or directly into production.

Missile Command

A90-050 TITLE: Pulse Jet Engine Technology

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: The pulsejet, due to the inherent mechanical simplicity of such engines, has the potential of being developed into an extremely low cost air breathing propulsion system. Such a low cost propulsion system may be suitable for targets, decoys, training rounds, and low cost weapons. Innovative pulsejet concepts are required that lead to improved engine reliability and performance without adversely affecting cost. Critical technology areas that should be evaluated are: fuel injection/ control systems, valves, ignition/start systems, and materials. Airframe/engine integration should be considered in any concept evaluations. Emphasis should be placed on the theoretical and experimental evaluation of hardware designs. The static thrust range of interest is 50 to 200 lbf. Flight durations of 20 minutes at maximum thrust are desired. The desired vehicle flight speed is subsonic above Mach 3.

PHASE I: Would involve the design, fabrication, and static testing of heavy wall engine.

PHASE II: Would involve design, fabrication, and flight-testing of a flight weight engine. Engines developed under both phases would be delivered to the government for evaluation.

A90-051 TITLE: Slug less, Multiple High Velocity Pulse Shaped Charge Jets

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Conceptually, there is an advantage in attacking tank armor repeatedly in the same spot with jets formed by shaped charge warheads. Currently, practical devices are limited to the formation of tow jet “pulses” because of the formation of a slug (a concentration of slow moving shaped charge liner material) for each high velocity jet pulse. The development of slug less, high velocity jets combined with shaped charge designs that produce three or more pulses should have a significant performance advantage in terminal homing missiles.

PHASE I: Should identify technical approaches, and determine which are feasible based on modeling and simulation. Phase I should end with the selection of the most promising design approach to be pursued in Phase II. The design approach selected should be capable of defeating multiple layers of reactive armor sandwiches, which are located within a one-meter path.

PHASE II: Will demonstrate, through fabrication and firing tests, that the design approach will perforate multiple layers of reactive armor, as well as passive armors. Phase II will be structured to permit the demonstration of the design to occur through successive iteration (approximately three) of fabrication and test.

A90-052 TITLE: Low Cost Collapsible Mandrel Substitutes

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: A Filament winding and other composite material fabrication technique often requires mandrels, which must be removed through small openings. A number of various procedures are in use such as collapsible metal tooling, inflatable tooling, sand wash out, wax melt out and eutectic alloy melt out materials. Each of these may serve in a particular area, but each has significant disadvantages so as to prevent its universal usage. A material is needed which readily forms to the required mandrel dimensions, resist the temperature and handling stresses inherent in composite parts fabrication and, then is just as readily removed without leaving residue inside the finished part.

PHASE I: This effort will consist of evaluation of various materials and/or techniques that will meet the requirements described. It is anticipated that several approaches will be tried before the right combination of strength, temperature and ease of removal is developed. This phase is exploratory development and should culminate with a demonstration of the technique to be used for mandrel fabrication and removal.

PHASE II: This phase will consist of fabricating several mandrels of different configurations. On these mandrels, composite structures will be fabricated. These structures will use different composite materials and will require different cure procedures. This is also exploratory development. The success of this phase will depend on the ease of making the mandrels, how well they hold up during fabrication, and the ease of removal form the finished part.

A90-053 TITLE: Drag Brake/Wing Deployment Mechanization

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Missile which must fly & considerable distance at a relatively high velocity and then slow to a very slow velocity for part of the mission could fly out on the body-tail lift and then deploy wings for the slow phase of flight. One concept under consideration for FOG-X has four wings folded aft along a square fuselage. The wings would deploy to an intermediate position to serve as drag brakes and then fully deploy to act as wings. This task consists of designing, fabricating and testing a mechanism for deploying four panels, which would serve as both drag brake and wing. The wings should deploy to an intermediate position as a drag brake during the deployment from drag brake to wing. The wings should deploy in such a manner that very small changes in aerodynamic moments are generated due to differences in deployment position. It is of utmost importance that the mechanisms involved in the deployment be simple and use as little internal volume in the missiles possible. The internal volume of the wing could be utilized.

PHASE I: Activities should provide a basic design and supporting analysis including stress analysis. Engineering drawing should be provided for review.

PHASE II: A full-scale model is required and it shall be required to demonstrate the deployment mechanisms against loaded wing panels.

A90-054 TITLE: Alignment Transfer for Helicopter Launched Inertially Guided Missiles

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: The accurate transfer of alignment from a helicopter stabilized tracker platform to an Inertial Measurement Unit (IMU) package on-board a missile being carried by that helicopter is the key capability needed to achieve a true long range fire and forget capability via an inertial strap down navigation midcourse and autonomous handover to a terminal seeker for final homing. Innovative non-interference hardware and processing concepts to continuously measure angular motions of the missile while it is mounted on the launcher, relate these motions to the helicopter's stabilized target track line-of-sight, and perform alignment transfer immediately prior to launch are required. Missile IMU to helicopter stabilized tracker alignment 5 to 10 times more accurate than current launcher motions are required. The new helicopter transfer alignment system shall require little or now crew interaction as an autonomous part of the launch process.

PHASE I: Activities should provide a basic design, supporting analysis, and a laboratory breadboard demo of the basic missile motion measuring mechanism.

PHASE II: Activities should provide a brass board demonstration of the alignment transfer on a representative helicopter/missile system.

A90-055 TITLE: Electro-Mechanical (EM) Actuator Driver

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: High efficiency, high packaging Density Pulse Width modulation (PWD) motor drive circuits are required for EM control actuators for lightweight missiles. There exists a need for low cost, fully integrated H-bridge circuits capable of switching up to 50 volts at 5 amps to provide bi-directional control of single/multi-phase DC motors. Circuit input is required to be TTL level pulses. Complete circuit drive one (1) motor shall package in 0.8 cubic inch or less and operate continuously at 20 percent duty cycle without external cooling. This effort is exploratory development.

PHASE I: The objective of the first phase of the proposed efforts is to design, fabricate, and test a prototype circuit. The configuration of this prototype shall sufficient to prove the basic functional performance of the design. Although this prototype shall not be required to meet the size constraints, it shall be demonstrated by analysis that the proposed design can meet the size and power dissipation requirements in the final (Phase II) form.

PHASE II: The objective of the second phase of this effort is to design, fabricate, and demonstrate a fully integrated package which meets the size and power dissipation requirements as described above.

A90-056 TITLE: Synthesis of Cadmium Sulfide

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: Cadmium sulfide, in single crystal form, is in the STEMGER POST missile system. Present production processes suffer from many problems, some of which result from difference in the properties of the cadmium sulfide power used to grow the single crystals. Research is required to complete the development of the spontaneous reaction between dimethylcadmium and hydrogen sulfide, which yields highly pure cadmium sulfide.

PHASE I: Results from spectroscopic and stoichiometric analysis will be combined with results from x-ray diffraction and scanning electron microscopic analysis to show that each production batch is highly pure and the same. Analysis, results, and samples will be supplied to us in appropriate reports.

PHASE III: Enough powdered cadmium sulfide will be produced to grow several single crystals of cadmium sulfide. Several will be forma unit production of cadmium sulfide and several will be from combinations of several productions of cadmium sulfide. Analysis, results, samples and single crystals will be supplied to us in appropriate reports. (Basic Research)

A90-057 TITLE: Acquisition and Classification of Helicopters in Defilade

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Threat helicopters may utilize nap of the earth maneuvering to screen themselves form conventional ground based surveillance systems. Techniques are needed to detect, discriminate and classify these threats so that fire, counter fire, or avoidance can be implemented by our weapon systems. Concepts may utilize active or passive sensors for this exploratory development program.

PHASE I: Concept description and feasibility studies that predict sensor performance to distances greater than 8 kilometers are required. Measured data when available should be utilized in the studies. Deliverables shall include reports and any computer codes utilized.

PHASE II: Sufficient hardware shall be assembled/developed and utilized in the studies. Deliverables shall include performance in field experiments

A90-058 TITLE: Observer Degradation Model

OBJECTIVE: Support the inclusion of observer degradation effects on targets for hardware-in –the –loop simulation.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Innovative methods are needed to include the degradation effects of an observer on a three-dimensional, infrared target model as the observer views it. These methods must account for the image degradation due to the effect of range variation on image resolution. The methods must also account for effects such as the observer spectral band pass and spectral response curve. The methods must be shown to agree with data taken at various ranges. The techniques developed must be capable of running on UNIX-based engineering workstations such as the IRIS 4D/70 Graphics Turbo, and must require minimal human intervention in their operation. This work should be considered Exploratory Development.

PHASE I: Production of computer software capable of running on MICOM's IRIS 4D/70 GT workstations which fully satisfies the objectives described above.

PHASE II: Extend the software in PHASE I to encompass a closed loop, 6 Degree-of-Freedom flight simulation for a missile and plume as viewed by an imaging infrared sensor. The extended software must account for observer degradation effects such as the fields of view (both total and instantaneous), blur circle size, detector pixel array geometry and response, point-spread function, and signal processing. All pertinent effects must be included so as to produce the time dependent signal(s) that would be injected into a seeker breadboard during a hardware-in-the-loop simulation. Also, the extended software must be capable of modifying and/or degrading the three-dimensional, infrared target model file to appropriately account for the above mentioned effects such that a new three-dimensional, infrared target model file is produced. The identification of various distinct parts of the model (such as wings or tank turrets) must be maintained in separate sections of the new faceted, 3D, target model fine format model file. The format of both the original

and new target; model fillies will be specified by the Government. The software developed must be capable of running on the IRIS 4D/70.

A90-059 TITLE: Infrared Target for Testing System Resolution

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: The rapid growth in the number of military systems that utilize sensors has placed increased demands on system testing. Some important elements include that of measuring the resolution of infrared sensors and determining the effect of line-of-sight stability on system resolution. Many military systems could benefit from such an exploratory development program and the end item will be marketable to the tri-services.

PHASE I: This will be an exploratory development stage that will include engineering analysis to demonstrate the feasibility of building a device with the characteristics outlined below.

PHASE II: Infrared targets are required in order to support field/captive flight-testing of infrared sensors. Characteristics required for the infrared targets include: a target board with dimensions 3 meters X meters (not including a 1 meter border), the capability of varying the number of he bar targets (vertical, horizontal) at least once every two minutes. Other requirements include the capability vary to the target to background temperature difference from 1.5 to 10^{o} C with an accuracy 0.2^{o} C and to maintain the background temperature within 0.2^{o} C of ambient. The system should also be capable of changing the temperature difference from maximum ($+10^{o}$ C) to minimum ($+1.5^{o}$ C) within a 2-minute period. In addition, the systems should be computer controlled with the capability to remotely command a vertical or horizontal bar orientation stage that will include delivery of hardware meeting the requirements outlined above. If the end item meets the technical requirements, this device will fill a need for the tri-services.

A90-060 TITLE: Power Transmission Utilizing Laser and Electro-optic Technology

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: A method is required to remotely power missiles and telemetry electronics during Electromagnetic Environmental Effects Test. While testing these effects, power cannot be delivered using conducive wires, which would change the test fields. Currently batteries are used to power the missiles and telemetry. The batteries have to be replaced often, which means a time consuming disassembly of the missile under test. Currently being explored is the use of electro-optic power conversion technology to meet the power requirements. The idea is simply to convert laser power guided to the missile by nonconductive fiber optic into electrical power capable of powering the telemetry. The small size of the conversion module, less than two inches in diameter and two inches in height, and the power regulation requirements further limit and challenge the design. The needed hardware includes a laser, fiber optic transmission cable, and a power module Preliminary design and fabrication of proof of concept of the power modules is proceeding in-house.

PHASE I: Would be the final design and fabrication of a test power module.

PHASE II: Would produce form one to three fully operable systems to be utilized for extended proof-of-principle tests.

NATICK RDE Center

A90-061 TITLE: Easy Open Metal or Polymeric Tray Pack

OBJECTIVES: To design and develop easy open feature for present metallic Tray Pack or polymeric Tray Pack under development.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: The present metallic Tray Pack has to be opened using a can opener. It is desired to have an easy open feature that will eliminate the need for a can opener. It must be taken into consideration that the can must be able to withstand the rigors of military handling. A polymeric Tray Pack is under development at this time. The easy open method must be developed for the tray as well

PHASE I: Conduct a study and report findings as to the feasibility of an easy open design feature for the present metallic tray pack can and its polymeric equivalent. Both trays are approximately 10 X 12 X 2 inches in size and hold approximately 100 ounces of thermally processed foods.

Produce a quantity of prototypes for evaluation.

PHASE II: Produce, test and deliver to Natick a quantity of easy open tray pack cans, both metallic and polymeric. Tray packs shall be filled, sealed, thermo processed and abuse tested prior to delivery to Natick for further evaluation.

A90-062 TITLE: Thermal Manikin Design and Fabrication Utilizing Heat Pipe Technology

OBJECTIVES: To fabricate a thermal manikin test apparatus utilizing heat pipe technology to achieve ISO thermal surface temperature over the entire surface of the manikin's human form shape.

CATEGORY: Exploratory Development/Advanced Development/Engineering Development

DESCRIPTION:

GENERAL: A thermal manikin apparatus is utilized to measure heat transfer properties of clothing and equipage in order to establish their environmental limits. A need exists to review a government generated base design plan for 17 zone thermal manikin, fabricated from heat pipes to achieve isothermal surface temperatures. In Phase I, design changes, modification and improvements, as appropriate, will be prepared to achieve a functionally sound and complete manikin design package, which meets specific performance requirements. Phase II requires manikin fabrication based upon the Phase I design.

A90-063 TITLE: Eye Protection Against Tunable Laser Sources

OBJECTIVE: To demonstrate principle and construct system for significantly attenuating all wavelengths of light from 400-1065 mm.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: While protection against a reasonable number of fixed laser wavelengths appears technologically feasible, simultaneous and instant protection against all laser wavelengths in the visible and very near infrared, by a method feasible for the low weight, bulk and power requirements has not yet been demonstrated. Methods

and materials are sought which should provide instant (sub nanosecond) attenuation of all wavelengths of light in the visible and very near infrared region of the spectrum. The normal state of such a system should provide a high level of transmittance, very low level of distortion, and wide field of view.

PHASE I: The first phase will include all work necessary to establish the soundness of the proposed approach, including demonstrations of the scientific validity of the approach, where appropriate. The first Phase will also include experimental verification of the principle proposed, in the form of breadboard demonstration of the effectiveness of the approach against any arbitrarily selected visible of near infrared wavelength (to 1064 mm), and indicate its potential for use in a light weight head borne device.

PHASE II: The second Phase shall include refinement of the principles demonstrated in Phase I, to optimize desirable operation characteristics and reduce or eliminate shortcomings or inadequacies.
The second phase shall also include the construction of several complete demonstration goggle-type devices. Such devices shall retain or improve all of the required protective characteristics of the Phase I device, but shall also permit evaluation of their essential characteristics, including recovery times, field of view, optical distortion, durability, etc. Potential manufacturing problems should be discussed and addressed.

A90-064 TITLE: Integrated Ballistic Casualty Reduction and Ballistic Protection Model

OBJECTIVE: At the completion of Phase II, an automated computer simulation model will exist that will allow designers and manufactures of individual ballistic body armor to rapidly asses the effects of design/material changes on performance in order to optimize specific designs. This will be accomplished through an interactive process that assesses changes in the armor's casualty reduction potential resulting from any design/material changes. The model will simulate various ballistic impacts from a range of appropriate threat weapons.

CATEGORY: Exploratory Development

DESCRIPTION:

PHASE I: Optimize existing computer simulation programs that describe projectile penetration and ballistic protection effects for new computer hardware. Extend methodology to predict the effects that varying body armor materials, design, and construction have on casualties.

PHASE II: Integrate the optimize and extended methodologies of Phase I into an overall, user friendly menu driver, stochastic program to specifically support the development of optimize body armor protective systems.

PHASE III: Development both graphic and tabular output routines for the simulation model and provided for multi-user access on commonly available engineering workstation on parallel processor computer.

A90-065 TITLE: Novel EM Gasket Concepts for Tactical Shelters

OBJECTIVE: Develop gaskets to replace existing inadequate gaskets.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: The door seals on electro magnetically shield tactical shelters are typically made of metal mesh gaskets. It is know that these gaskets deteriorate rapidly due to corrosion and compression set. Metal finger type gaskets require precise door assignment, frequent maintenance, and are susceptible to physical damage. Novel designs and methods are needed for making electrical contact around shielded doors. Novel designs should require only low closure/compression force, should provide high shielding effectiveness (greater than 60 dB at 100 kHz, magnetic), should be of rugged construction, and should provide a long service life with only minimal maintenance.

PHASE I: The effort would consist of generating gasket concepts fabricating prototypes, and performing bench top, proof of concept test on the prototypes.

PHASE II: The effort would consist of fabricating or purchasing quantities of the most promising gasket designs, and using them to conduct full scale performance and evaluation test.

A90-066 TITLE: Development of a Lightweight, quiet, power source.

OBJECTIVE: To develop a lightweight, quiet power source to be used in the development of a man-portable microclimate cooling backpack.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: The proposed program is for the design and construction of a lightweight, quiet power source that will be ultimately used to power a microclimate cooling backpack. Currently, there in no commercial source of power sources of the size, weight, power, and fuel utilization required for backpack application.

The power source can deliver either shaft or electrical work. If the output is shaft work, the power source will be used to drive a compressor as part of a vapor-compressing refrigeration loop. If the output is electrical, the engine will be used to supply power to either an electrically driven compressor or a thermoelectric cooling device. Power output should be greater than 300 watts and the device should be quiet, vibration free, efficient, easily operated and maintained and weigh less than five pounds. Since this device will be used for backpack applications, keeping the weight to a minimum us essential.

PHASE I: The contract will be for the preliminary design concept. Enough data will be developed in this phase to permit assessment of probable success.

PHASE II: Will be for the development and construction of a working prototype.

A90-067 TITLE: Processing and Spinning of Protein Fibers

OBJECTIVE: To identify optimal processing and spinning requirements for the formation of high strength fibers based on fibrous proteins.

CATEGORY: Basic Research and Exploratory Development

DESCRIPTION:

GENERAL: Current research efforts are focusing on genetic manipulation of natural systems for the production of new protein-based polymers. These bioengineered materials can be produced in relatively large quantities in fermentation systems from recombinant organisms.

PHASE I: To develop processing requirements for the isolated fibrous proteins to prepare these products for fiber spinning. To develop fiber spinning conditions to optimize desired performance such as high tensile strength. To produce sufficient quantities of fibers for evaluation of fiber performance.

PHASE II: To scale-up the processing and spinning conditions developed in Phase I to produce sufficient quantities of fibers for full scale evaluation of fiber performance as a woven material.

A90-068 TITLE: Coated Fabric for Five Soldier Crew Tent (FSCT)

OBJECTIVE: Develop fabric to replace existing FSCT fabrics

CATEGORY: Advanced Development

DESCRIPTION:

GENERAL: Develop fire, water and weather resistant fabric that would also address NBC threats.

FSCT fabric – SBIR

The army has a need for a new, lightweight, fire, water and weatherproof fabric for the newly developed Fire Soldier Crew Tent. The existing fabric cracks and delaminates following short-term exposure. A new fabric is needed that will:

1) Be less than 70 oz/yd^2
2) Meet or exceed federal STD 5903 for fire resistance
3) Have minimum physical characteristics of:
    a. Breaking strength, wrap and fill, 175 lbs.
    b. Tearing strength, wrap and fill, 175 lbs.
    c. Stiffness, wrap and fill, maximum at
        $+70^o$ F -/- 20^o F 0.005 X 0.005 inch pounds
        -20^o F -/- 5^o F 0.200 X 0.200 inch pounds
    d. Water repellency
        1) Hydrostatic resistance, centimeters, minimum, held for 10 minutes: 50 cm initial and 50 cm after $–40^o$ F cold crack.
        2) There shall be no evidence of cracking after cold soaking and creasing of the specimens.
    e. Adhesion of laminated film or coating, 10 lbs per two inch width, initial and after ultra violent light exposure
    f. Be capable of accepting a camouflage pattern coating.

This new fabric must conform to the requirements of NBC Survivability as defined in AR 70-71.

PHASE I: Determine if stated minimum requirements are feasible with current state of the art techniques and materials. Determine if any trade-offs may be required to achieve the desired physical performance characteristics and provide the ramifications of each. Investigate commercially available, no developmental materials, which may posses the desired minimum requirements and determine prototype cost estimate.

PHASE II: Initiate material development program to continue exploration of promising materials with the goal of obtaining a quantity of prototype yardage to be used in actual end item test applications.

Tank Automotive Command

A90-069 TITLE: Robotic Convoy Capability

OBJECTIVE: This program will provide another tool for potential users of robotic system to enable them to achieve multiple vehicle control. The objective is to develop a system of sensors and controls, which will allow unmanned vehicles to autonomously follow either a manned, or another unmanned vehicle. Robotic convoying controls several vehicles at the same time.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: In the deployment of numerous robotic vehicles from a single Robotic Command Center (RCC) it would be desirable to have the capability to teleoperate one robotic vehicle while having the other robotic vehicles autonomously follow the teleoperated vehicle in a convoy formation (i.e., robotic convoy). This robotic convoy system using currently available hardware

PHASE I: In the phase I effort the contractor shall design and document a robotic convoy system. The design will need to specify the required sensors, processor, communication system, navigation system etc., and specific details as to how the components will be integrated together. Any system configuration developed should employ currently available hardware only. Expected system performance capabilities e.g. speed, following distance, lateral position errors, etc., will need to be estimated. Supporting technical rationale for component selection, integration, etc. should also be provided. Documentation shall be sufficient to enable the fabrication of a breadboard prototype in a subsequent phase II effort. Minimum documentation requirements are as follows: concept sketches, Subsystem and system functional specifications/block diagrams/performance capabilities, detailed system description and a final report.

PHASE II: IN the phase I effort, the contractor shall fabricate and test a breadboard prototype robotic convoy system in accordance with the design developed in Phase I. The government for implementing the robotic convoy system will provide vehicle. Field tests will be conducted to explore the performance capabilities of the system. The following items shall be deliverable under this effort: Design drawings, Test report, Finial reports and the Breadboard prototypes.

A90-070 TITLE: Advanced Concept Evaluation (ACE)

OBJECTIVE: Design and demonstration of advanced desktop/laptop workstation computer software for complete design and evaluation software on advanced PC, PS or workstation units.

CATGORY: Exploratory Development

DESCRIPTION:

GENERAL: These are various armor design and evaluation models for different threats and different armor system types. They come in many sizes and capabilities and are usually created by armor design and test experts, not computer software, graphics, or hardware experts. The computer models are executed on general-purpose processors of one type or another, but seldom on dedicated state-of-the-art hardware system. The armor concept design and evaluation would require excessive time and effort. This effort seeks innovative concepts and design using state-of-the-art and available hardware at the U.S. Army Tank – Automotive Command, and specially packaged armor design/evaluation software for the creation of dedicated desktop/laptop workstations for concept vehicle armor design and evaluation against KE and CE threats of all sizes. This effort seeks new interactive computer aided software and techniques that will reduce combat vehicles armor concept design and evaluations to within days instead of taking weeks.

PHASE I: Literature, technology, and TACOM hardware survey, Concept development, System design and analysis.

PHASE II: Component software development, test, and assembly, System packaging, System testing, demonstration, and documentation.

A90-071 TITLE: Cold Start Systems

OBJECTIVE: Cold Start techniques for military diesel engines shall be developed allowing for quicker more reliable starts down to –25 F without external aids and to –60 F with arctic auxiliary kits.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Current high output military low compression ratio diesel engines have difficulty in meeting cold start specifications. Simpler techniques are requiring improve cold start capability. All starting hardware should be rugged and compact, capable of integral vehicle installation. The prime vehicle fuel, diesel, or its alternative, should be the only fuel required. High flash point fluids such as ethers and nitrates are.

PHASE I: The cold start design concept shall be completed with estimates of cold start capabilities and improvements provided. Drawings should be furnished demonstrating how the system could be integrated into a military propulsion system design.

PHASE II: The system described in Phase I shall be fabricated and demonstrated on an engine in cold room tests. Baselines to new configuration cold start test results shall be make and compared to demonstrate improvements.

A90-072 TITLE: Robotic Vehicle Communication Controller

OBJECTIVE: The objective of this effort is to design, fabricate and test a communication controller, which would manage the information that is passed over the communication link between robotic vehicles and robotic command centers. The information communicated between vehicles would be greatly reduced by allowing only that information which is of true value to other members of the network to be communicated. This would allow more robots to be operated in the same area.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: The Army anticipates that multiple robotic systems will be operating in close proximity to each other. Each robotic system would consist of a Robotic Command center (RCC) controlling up to four robot vehicles (RV). The RV would perform a variety of missions including weapons firing, NBC detection decoy, recon, mine detection and clearing and target acquisition and designation. The command, control, communications and intelligence requirements of such a robotic fleet require the improvement of present communication control technology. I t is anticipated that there would be two way message traffic from RV to RV, RV, to RCC, to RCC, and RCC to a Central control center. The Army envisions the development of a black box to be integrated in to the RCC and RV's which would manage the communication network determine 'who' needs 'what' information and 'when'.

PHASE I: The phase I objective is to determine the feasibility of developing a black box which would be placed between robot vehicles computers and the radios to manage the information flow into and out of the vehicle. The black box would determine what incoming information is needed by the vehicle and what information available from on board sensors is needed b other members of the network. Block diagrams should be developed to show modules, which would make up the black box. Functional descriptions would be provided for each module.

PHASE II: In phase II, the contractor will fabricate the black box on the concept developed in phase I. Hardware will be built and software written to perform the functional modules described in phase one. The black boxes will be integrated on the Government supplies RCC and Robotic Wiesel Vehicles for testing gat FT. Knox.

A90-073 TITLE: Variable Valving Mechanisms

OBJECTIVE: Mechanical, hydraulic variable valve timing/lift variation mechanisms are to be designed, built and demonstrated. These systems may be directly or micro-processor controlled.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: The system to be designed should allow variability in valve events as well as opening and closing rates. Potential Benefits include: improved engine transient response, provide for engine braking, more optimized cold starting and ability to optimize a chosen engine function throughout its operation range.

PHASE I: The variable valve timing system design concept shall be completed in this phase with engineering estimates on performance and potential applicability to modern diesel engines provided. Estimates such as valve lift/rate of lift versus time and system power requirements shall be provided as well as drawings as to how system could be incorporated into modern diesel engine designs.

PHASE II: Feasibility of the variable valve timing shall be demonstrated. The demonstration shall be accomplished on a single cylinder diesel engine, four valve head configuration.

A90-074 TITLE: Ruggedized, Low Cost, Engine Mounted Oil Analysis Sensor

OBJECTIVE: Development of an Engine Mounted Oil Analysis Sensor which can be mounted on an vehicle/engine and perform detailed oil analysis in real time.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: The Army requires a low cost engine mounted oil analysis sensor. Significant manpower materials, and facility resources are currently committed to the Army Oil Analysis Program. Increased program effectiveness and lower program cost could be achieved through the implementation of real time engine of analysis with engine mounted oil analysis sensors.

PHASE I: During Phase I, the effort would demonstrate the capability of performing real time oil analysis and would be completed with a technical report documenting the preliminary design of the sensor.

PHASE II: The Phase II effort will consist of design, fabrication, and evaluation of the Oil Analysis Sensor. This sensor would demonstrate the capability of performing real time spectroscopy or other real time oil analysis suitable for the detection of oil contaminants' particulates sizes, densities and identities: first in a laboratory environment and then in a Government dynamometer facility with a contractor supplied breadboard sensor.

Test and Evaluation Command

A90-075 TITLE: Explosive Noise Abatement

OBJECTIVE: To employ the required technique for noise attenuation of a small explosive (approximately 25 pounds) charge test.

CATEGORY: Exploratory Development

DESCRIPTION: (Statement of Work)

GENERAL – The testing of Army material routinely involves detonations of 25 to 100 pounds of high explosives. These detonations are performed outdoors. Some meteorological conditions cause the noise produced by the testing to be focused to areas outside the military reservation. This noise is an annoyance to neighboring residences and in extreme cases has resulted in property damage.

PHASE I – The objective of this research is to pioneer a method of device for attenuating the noise level by 10 decibels in order to allow testing to be performed under most meteorological conditions. The method or technique employed shall have the capacity to handle a test item, which occupies the equivalent volume of a 30-foot cube.

PHASE II – The objective is to employ the required technique for noise attenuation of a small explosive (approximately 25 pounds) charge test.

A90-076 TITLE: Improved Performance of High Energy Laser System

OBJECTIVE: Accomplish performance improvements of High Energy Laser exhaust System.

CATEGORY: Advanced Development

DESCRIPTION: (Statement of Work)

GENERAL – The exhaust of the high-energy chemical laser contains components that are hazardous in nature; Specifically, Hydrogen Fluoride (HF) and Nitrogen Tri-Fluoride (FM3). Present meteorological models often predict that a hazardous toxic corridor of excessive length will occur. Based on this prediction, laser testing is held in abeyance until the models predict improved conditions. The predictions of these models significantly impact the test schedule of the nation's only Tri- Service Laser Test Facility and delays incur significant cost to the government. The inputs to these models are presently based on a rough and invalidated empirical analysis. The characteristics of the exhaust system are not well understood and what is assumed is not validated. The existing methods for estimating scrubbing efficiency and effluent composition is highly susceptible to error and accounts for only 80 of the effluents of concern and should be improved to address all exhaust components.

PHASE I – The research activity would investigate methods of accurately determining exhaust system efficiency, then evaluate modifications to be made to the laser exhaust scrubbing system to improve the efficiency of scrubber performance and effluent/air mixing.

A90-077 TITLE: Rapid Active Small Arms Scoring System

OBJECTIVE: The prototype system will be developed into a production unit. The system will be refined and redesigned to maximize performance and minimize physical size and cost.

CATEGORY: Engineering Development

DESCRIPTION: (Statement of Work)

GENERAL – There currently exists a need to accurately score subsonic and supersonic small arms projectiles fired in single and burst modes. To date, a satisfactory, commercially available system has not been identified which can accommodate the requirements identified.

PHASE I – A "burst mode" small arms scoring system is required for use at various firing ranges. This system must capable of handling burst rates of up to three thousand rounds per minute including duplex round (fixed in burst mode) and flechettes (fired in burst mode). Accuracy of the calculated impact point must be less than one centimeter from the true impact point on rounds as small as 5.56mm diameter. The system must be an active system i.e., the system will provide its own light source (such as laser diodes used in conjunction with photo detectors) and not rely on passive lights.

PHASE II: The phase II effort will involve the prototyping of a scoring system for evaluation of system accuracy, reliability and operational ease.

A90-078 TITLE: Scenario Generation for the White Sands Air Defense Test Bed

OBJECTIVE: Design and develop a prototype Scenario Generator Workstation using existing equipment Demonstrate feasibility to integrate the workstation into the existing SUITE of WSMR test and evaluation computer instrumentation via a Local Area Network (LAN).

CATEGORY: Exploratory Development

DESCRIPTION: (Statement of Work)

GENERAL - The Scenario Generator (SG) Workstation will make maximum use of existing White Sands Missile Range (WSMR) equipment. The WSMR SG equipment consists of color graphic display, keyboard, digitizing tablet, printer, VAX II-750 computer and local area network. The SG will accept user-entered data and through a series of prompts and menus will guide the scenario developer to build the scenario. The SG will provide a detailed air and ground picture overlaid on a digitally stored 3-D terrain map and will provide a sequence of events to comprise a scenario. The air and ground picture will include aircraft and ground maneuver units with masking and corridor overlaid.

PHASE I –Develop the specifications for the design and development of the Scenario Facility. The specifications shall include the system specification (A-level), the development specifications (B-level),and the intent of MIL-STD-490 and DOD-STD-2167. The cost, risk and utility tradeoff analysis studies used to develop the design shall included in the contractor's product.

PHASE II: Develop the prototype scenario generator workstation software according to the specifications developed during Phase I. The software shall be tested and demonstrated on the existing VAX 11-750 equipment at WSMR. An interface shall be developed to port the data via local area network to other existing computer systems at WSMR.

A90-079 TITLE: Vehicle Mounted In-Situ Real-Time Dust Measurement System

OBJECTIVE: The manufacture of a dust measurement device with the following characteristics: measure dust concentration in place (without sampling), dust levels to 20 gm/m3, small sensing unit (cigarette-pack size), particle –size compensation, and real-time read-out (seconds).

CATEGORY: Engineering Development

DESCRIPTION: (Statement of Work)

GENERAL –Development of a real-time in-situ dust measurement system with small sensing unit suitable for mounting on military vehicles undergoing dust testing.

The airborne dust concentrations around military vehicles undergoing test can vary form milligram levels to levels exceeding 20 gm/m3 with some particle sixes exceeding 100 microns. The average particle size can vary by nearly a factor of 10 between areas of high dust concentration and low concentration. This requires that the system has the capability of compensating for average particle-size change

An in-situ measurement is required because the large variance in particle size and the indeterminate flow velocities can cause large sampling errors. A small sensing unit is required to reduce disturbance to the measured airstreams and to allow more freedom in the placement of the sensor. A small sensing unit connects by a flexible umbilical to a larger control unit would be an acceptable concept. It is anticipated that some form of nephelometry could take advantage of the particle-size vs. wavelength response characteristics by using two or more widely disparate wavelengths such as 10.6 micron and visible/near-infrared to give varied weight to large/small particles. The relative response from the two nephelometers would be used to compute the particle-size compensation factor.

PHASE I –Theoretical and Engineering Analyses of the problems and capabilities of the proposed concept. Laboratory demonstrations of key parts of the concept desired.

PHASE II –Development, testing and calibration of field capable prototypes meeting the objectives stated for Phase III dust measurement systems.

A90-080 TITLE: Radar Signal Processor

OBJECTIVE: Development a prototype processor for an MPS-36 instrumentation radar that will perform such things as error signal normalization and adaptive tracking at the PRF.

CATEGORY: Exploratory Development

DESCRIPTION: (Statement of Work)

GENERAL: A number of monopulse instrumentation radar (e.g., FPS-16, MPS-36) are currently in use at the White Sands Missile Range (WSMR), NM and other military test ranges in support of the testing of missiles, projectiles and aircraft. These monpulse radars typically operate at C band with a Pulse Repetition Frequency (PRF) of 320 or 640.

Previous research has been conducted to investigate enhancements to these systems that could significantly improve their performance. It now appears feasible to incorporate these enhancements into the operation of the radars with a high-speed programmable digital signal processor. A system that extracted, for example, the digitized delta azimuth signal, delta elevation signal, sum signal, AGC level, etc., could perform real-time error signal extraction and perform coherent angle and fine line tracking research into additional enhancements that could be programmable interfaces for the radar, recording devices, displays, modems, and servo encoders.

PHASE I: Appropriate investigations under a Phase I effort include research of new techniques as well as the application (in concept) of previously developed ideas, that would proved improved radar performance. The research should determine the feasibility of real time application of the radar improvements identified and include a conceptual design of the required digital signal processor. The final results should indicate recommended approaches, rational, tradeoffs, and approximate cost.

PHASE II: Under a Phase II effort a system design should be well defined and a prototype system developed. The prototype should be tested in normal operational environments as well as under simulated conditions.

A90-081 TITLE: Projectile Follower Tracking Control Subsystem

OBJECTIVE: Construction and testing of a tracking control subsystem.

CATEGORY: Engineering Development

DESCRIPTION:

GENERAL: The projectile follower is a device capable of providing continuous, high speed photographic data of ammunition along 200 meter of the flight path. The system is capable of providing photographic information only if a predetermined flight profile has been programmed into the system. A flight profile must be developed from base line data (acquired from previous tests) concerning dynamic flight characteristics of the projectile. A real-time tracking subsystem is required that the system will be able to acquire the photographic information from a projectile with missing or unavailable flight data.

The projectile follower is described by Brown and Dickens in “Opt electronic Instrumentation Projectile Follower System for Ballistic Applications,” (Proceedings of the Society of Photo-optical Instrumentation Engineers, Volume 779, May 1987, pp 50-99).

PHASE I: The phase I effort shall consist of a feasibility study and a detailed design of a real time controller for the Projectile Follower. This controller shall be capable of locating a projectile's instantaneous position along it's trajectory and command the follower mirror subsystem to the proper angle such that the camera line position within the first 200 meters of its trajectory to within 0.25 meters. Control shall be accomplished at a minimum 60-Hertz rate with a maximum of 100 microseconds elapsed time between the instant that the projectile is at the determined location and required correction is initiated by the follower mirror subsystem electronics. The Phase I effort would consist of a feasibility study and detailed design of the tracking control subsystem.

PHASE II: The phase effort will involve construction and testing of a tracking control subsystem.

A90-082 TITLE: Testing Embedded Neural Network-Based System

OBJECTIVE: To fully develop the test tool developed in Phase II into a production system written in Ada. A portion of this effort would involve validating the test methodology and the software test tool embedded neural networks.

CATEGORY: Exploratory Development

DESCRIPTION: (Statement of Work)

GENERAL: A variety of Government and Industry funded research initiatives are underway to create, develop, and transfer to production, computational environments based on neural computing or neural networks. A number of these environments will require new knowledge and techniques, and these may vary to some degree with the computational model implementation of the model employed as compiler, operation system, and architectural technology of current systems. This task will establish a working taxonomy of computational models and neural computing techniques and build a test tool to assist in testing model features implemental in the environment to be tested, and address quality factors such as reliability, performance, correctness, and maintainability.

PHASE I: A number of computational environments based on neural computing or neural networks have reached the stage of commercial products. This may soon lead to embedded battlefield system employing such technology, yet the current test techniques and expertise will be totally inadequate to asses their the Phase I effort is to investigate a testing methodology and demonstrate feasibility of implementing this methodology into a software test tool to aid in the testing of neural networks embedded in battlefield systems. This task will establish a working taxonomy of computational models and neural computing techniques and build a prototype test tool. This prototype may aid in identifying and characterizing systems under development in terms of the taxonomy, generate, from a library of proven algorithms, benchmarks for testing model features implemented in maintainability. The initial prototype of the tool is acceptable in any suitable development environment. The ultimate target use of the tool dictates that the architecture selected will allow for a straightforward migration to the Ada language for production versions.

PHASE II: The objective of this effort is to fully develop the test methodology recommended in phase I into a more robust the test tool. This tool should assist in characterizing the system under development, generate or suggest benchmarks or methods to test a particular neural model. Assessment of quality factors such as reliability, maintainability, correctness and efficiency of neural networks would be addressed in detail at this time. At some point the tool should also make the network more visible to the tester; i.e., translate weights and biases into a higher level of abstraction closer to the actual decision process. This effort should consider the Ada language for the more robust version. A portion of this effort would involve validation the test methodology and the software test tool on embedded neural networks.

A90-083 TITLE: Multistatic Projectile Tracking Radar

OBJECTIVE: modifications to existing radar such as Sgt. York and Hawk radar units to demonstrate multitarget tracking capability. Real-time operation desired.

CATEGORY: Engineering Development

DESCRIPTION: (Statement of Work)

GENERAL: There is a requirement to track multiple small radar targets that are dispersed over a small region of the sky. The targets consist of sub munitions and the remnants of the artillery projectile from which the sub munitions were expelled. Modified Hawk air defense system radar can satisfactorily track the projectile up to the point at which the sub munitions separate from the shell. It is necessary, however, to track each sub munitions in order to provide real-time pointing data to optical instruments.

The Hawk radar is continuous wave (CW) type that provides a Doppler frequency that is a function of the target velocity relative to the radar. Position can only be inferred by integrating the velocity over time from the know location of the gun muzzle. A pulse –Doppler radar could be used to track the projectile, but it is likely that several sub munitions would fall into the range gate and, thus, would not be distinguishable from one another.

It has been suggested that the CW Hawk radar be used to illuminate the region that contains the targets. Several passive receivers would pick up the returns from the targets. The emitted signal from the Hawk would also be used by the passive receivers a reference frequency to determine the Doppler shift for each target targets relative to the receivers might then be computed by performing a Fourier transform of the complex return to extract the frequently associated with each target.

The relative velocities of the targets should then be used to resolve the target positions.

PHASE I: The proposals will be evaluated considering the depths of analyses for phase I in the areas of energy balance, physical layout, transmission, and mixing of the reference frequency, spectral analysis, velocity computations, correlation for velocities with targets, computation times, processing hardware required, and radar design. Consideration will also be given to the knowledge and experience of the principal researchers in the areas of digital signal processing, radar design, and in particular the Hawk and Sgt. York systems.

PHASE II: Modifications to existing radars such as Sgt. York and Hawk radar units to demonstrate multitarget tracking capability. Real-time operation is desired. It would be preferable if available assets were used to assemble the multistatic radar. Radar components forms the Sgt. York program are available as well as the Hawk radar.

A90-084 TITLE: Digital Filtering Using Simulation Models

OBJETIVE: Develop digital filtering algorithms and hardware, for use in both offline and real-time processing or trajectory data that utilize differential equation process models in the determination of the present state of a process. Trajectory data includes time, space position, derivative, and attitude.

CATEGORY: Basic Research

DESCRIPTION: (Statement of Work)

GENERAL: Digital filters are used in test range tracking instrumentation application to reduce the noise level in the collected data and provide better estimates of the trajectory parameters of objects being tracked. The motion dynamics exhibited by the many different types of objects tracked at test ranges varies greatly. Such objects include slow moving ground vehicles, helicopters, supersonic aircraft, 20 mm. Cannon bullets, high-speed missile and orbital vehicles. The types of tracking instruments utilized varies greatly also and includes optical (both film and video) tracking systems, and millimeter wave and microwave radars. Data rates available

from these tracking systems can vary form 60 to 15000 samples per second. Digital filters are used for processing data in both real time and posttest applications.

Polynomial process model are typically used to solve this wide range of problems requiring digital filtering primarily because these models can be used over a wide range applications, are relatively easy to apply, and are reasonably robust. While these filters function reliably, their performance is inferior to the use of other more accurate process models. The polynomial filters frequently introduce significant lag when the bandwidth is narrowed sufficiently to achieve adequate noise rejection performance. This attribute is potentially hazardous when such filters are used for in-flight safety calculations on high performance missiles. The use of a set of differential equations of motion, for the object being tracked, as a process model has been shown to produce superior performance has been achieved at the expense of using a much more complex algorithm that is tailored to a specific target. The process of developing such models has proved to be lengthy and labor intensive. These problems limit the potential for applying them to data collected from a wide range of targets

The need is to develop algorithms; techniques and hardware that take advantage of the performance available from the differential equation process modeled digital filters, while retaining the robustness and ease of operation that is characteristic of using the polynomial process models. A user-friendly system, which permits easy development of differential equation process modeled filters, that can be easily adapted to a wide variety of targets, is envisioned. The investigation should determine the filtering improvements that can be engendered by such an approach and the feasibility of developing this capability in both an offline and real time environment.

PHASE I: A Phase I effort should identify a number of possible approaches or variations of a single approach. Through analysis and simulation (utilizing real data in an offline mode), the filtering improvement of a specific approach over currently utilized methods, should be demonstrated. As part of this exercise should be a demonstration of its user friendly facility for tailoring its operating to the various operational environments.

PHASE II: Under a Phase II and identified approach should be implemented in a prototype system and again demonstrate its ability to improve filtering and provide user-friendly interfaces. A series of test should be run in which the system is interfaced with test range tracking systems. All documentation for analysis, software coding, test results, block and wiring diagrams, training, maintenance and repair should be included as part of the prototype system.

A90-085 TITLE: Measurement of Chrome Chipping in Gun Tubes

OBJECTIVE: A complete inspection system will be constructed that can measure the amount of loss chrome in 105mm and 120mm cannon tubes.

CATEGORY: Engineering Development

DESCRIPTION: (Statement of Work)

GENERAL: This project will develop instrumentation that can inserted inside a cannon tube to detect and measure the amount of chrome chipping that is present. This instrumentation will be an extension, second generation, or innovative replacement of existing instrumentation currently providing a qualitative evaluation of chrome chipping (available for observation at APG but will not be furnished to the contractor). The system must generate an image (video or other), determine good and bad areas, correct for geometric distortion, indicate the amount of chrome loss within the field of view, store this value and determine the location along the length of the cannon tube, record chrome loss as function of position, and indicate total chrome loss in the gun tube.

PHASE I: This effort will:

a. Analyze the inspection system and items currently being inspected.
b. Select and obtain hardware best suited for this operation.

c. Calculate the appropriate algorithms needed to produce the correct values for the amount of chrome loss.
d. Determine and develop a method to keep track of the longitudinal position of the viewing area.
e. If a video method is pursued deliver a working prototype, train APG personnel in the operation, and provide manuals covering operation and maintenance.

PHASE II: After a complete user evaluation of the prototype delivered in Phase I, a production model will be constructed to measure the amount of chrome loss in 105mm and 120mm cannon tubes. This unit must be rugedized to withstand the industrials shop environment and will incorporate design changes to eliminate any shortcoming detected during the evaluation.

A90-086 TITLE: Projectile Impact Point Scoring System

OBJECTIVE: Develop the parameters to measure the impact point, to a centroid accuracy of 1 centimeter, of dynamic ballistics fired projectiles on vertical target orthogonal to the line-of-fire.

CATEGORY: Advanced Development

DESCRIPTION: (Statement of Work)

GENERAL: Design the sensors, techniques and equipment necessary to detect, measure transmit, display and record (in real time and without operator intervention) the impact points of direct fired projectiles on a vertical target matrix 12.5 meters by 12.5 meters, located along the line-of –fire up to 4000 meters form the weapon. The smallest projectiles have a target-to-diameter aspect ratio of 400:1 and velocities in the range from 333 M/sec to 2000 M/sec. The system shall be developed to measure the exact point the projectile passes through the target vertical plane, measured by quadratic coordinates from the virtual center of the target, with the measurement of the impact point to a centroid accuracy of 1 centimeter for all projectiles fired, and transmit the data to the firing point via encrypted secure format. Secondarily, measure the projectile impact angle of incidence to an accuracy of 1 mil. The system shall perform via microcomputer concepts and operating parameters.

PHASE I: Conduct basic research and development to design the equipment an algorithms to measure cited parameters fro the projectile impact point, to a centroid accuracy of 1 centimeter, on large and small caliber ammunition on direct fire accuracy range, ballistically fired onto a vertical target orthogonal to the line-of-fire.

PHASE II: Design, fabricate, and install the prototype accuracy measurement system on a designated firing range. Conduct collateral data acquisition operations during actual direct fire test operations and verify the operational integrity and accuracy of the prototype system.

A90-087 TITLE: Holographic Imaging of Plume Particulates in the Laser/Target Interaction Event

OBJECTIVE: Engineering the hardware and methodology developed in Phase II so that a “generic”, standardized holography system can be manufactured, capable of being used at various locations, under varying laboratory conditions. Standardization will require construction of manufacturing jigs, fixtures, etc.

CATEGORY: Advanced Development

DESCRIPTION: (Statement of Work)

GENERAL: The placement of a high power laser beam, such as the MIRACL DF beam, on a material surface results in fast disintegration of the material surface, followed by recession of the target material under the laser footprint, and expelling of the target material in the form of gases and solid particulates (the plume). While the evolved gases play a small role in the interaction of the HPL with the plume, the major interference derives from the HPL scattering by the solid particles. While it is true that optical density (OD) measurements may be

made without imaging the particulates, such imaging will allow information to be extracted from the plume, which will shed light on the following:

a. The physics occurring at the laser/target interaction monolayer.
b. The nature of the chemical pyrolysis of the target.
c. The "structuring" of the plume according to particulate size.
d. The cross section for HPL laser interaction with the particulates, when used with OD measurements
e. A direct comparison with post-plume particle gathering to help determine post-plume oxidation conditions and the efficacy of the downstream particle gathering experiments themselves.

Deep Field holographic imaging will allow the experimenter to focus into the plume, layer by layer, and thus to view the plume in slices for detailed examination. Since most plume particles are small, the magnification capability of the hologram must be great to allow imaging of micron-sized particulates. Additionally, plume particulates traveling at high speeds places great constraints on the resolution of the hologram formation system.

PHASE I: It is the objective of phase one of this effort to define the instrumentation and conditions necessary to accomplish holographic imaging of particulates generated in a high powered laser (HPL)/target interaction prevent. The phase I study will result in an experimental plan to delineate a set of experiments designed to result in the demonstration of hologram formation and reconstruction to satisfy the above requirements. Included in the study will be a complete literature search (the bibliography of which will be reported), a survey of the concurrent similar efforts, and the composition of a formal plan presented to eh appropriate government personnel for approval.

PHASE II: The objectives of phase II are two in number as follows:

a. To demonstrate the hardware and methodology necessary to perform the task of the holographic image recording of small, fast laser plume particulates (typified by the MIRACL targets plumes) and the reconstruction of the hologram.
b. To manufacture one complete holography recording and reconstruction system for use with MIRCAL in the HFLSTF effects test area.

The deliverables will consist of the complete holography system and detailed documentation to the level necessary t completely disassemble, do component checkout, reassemble, calibrate, and perform systems checkout prior to use in MIRACL laser.

A90-088 TITLE: Accelerated Corrosion Testing of Military Vehicles

OBJECTIVE: To verify the accelerated corrosion testing methodology developed. This includes subjecting a sample of new military vehicles to the accelerated corrosion test and comparing the results with vehicles, which had been previously fielded and used in a corrosive environment.

CATEGORY: Exploratory Development

DESCRIPTION: (Statement of Work)

GENERAL: The Army procures military vehicles to be used both on and off road in a variety of environments. Manufactures are required to apply corrosion preventive compounds to military trailers and vehicles to prevent rusting in conditions of heavy rainfall, high humidity, snow, salt spray, acid rain, tropical environments, and areas with industrial or atmospheric pollutants. During technical testing, the requirements of the purchase contract are verified, but the shortfall in the test process is the lack of a method to verify the effectiveness of the rust proofing application. A rust proofing application that is supposed to last 10 years cannot be verified without methods to simulated the environment and accelerate the corrosion. There is a requirement to develop a accelerated corrosion test (applicable to entire vehicles, not just selected components) that will simulate 10 years of corrosion growth within one year or less.

PHASE I: Perform a test methodology study (concerning accelerated corrosion testing) to determine the effectiveness of the rust proofing application for military vehicles.

PHASE II: Verification of the testing methodology developed during Phase I. This phase will include subjecting a sample of new military vehicles to the accelerated corrosion test and comparing the results with vehicles to the accelerated corrosion test and comparing the results with vehicles, which had been previously fielded and used in a corrosive environment.

Ballistic Research Laboratory

A90-089 TITLE: Compact and Field-Worthy Ultraviolet Laser

OBJECTIVE: Demonstration and Delivery of an Operational UV Excimer Laser.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: There exists a great need and substantial opportunity to develop a compact, light-weight, and field-worth ultraviolet (uv) laser for the United State Army. Thus laser should be able to operate at all of the UV excimer wavelengths: ArF (193 nm), KrCL (222 nm), KrF (248 nm), XeCL (308 nm), and XeF (350 nm). This type of laser is not commercially available and would be used for numerous applications, which include explosives and agent detection, explosives initiation, explosives initiation, and as an igniter for various propulsion systems. Design and performance goals include: weight < 10 lbs, volume = 2 cu. Ft. 25 mJ output pulse energy at 193 nm, 10-20 nsec pulse duration, gas fill lifetime = 24 hours minimum (ArF operation), 100 Hz rep rate, and unstable optical resonator.

PHASE I: An engineering feasibility study will be performed to determine the optimum electronic and optical design parameters required to build a scaled-down laser. An early prototype delivered to BRL for evaluation would be desired.

PHASE II: The electro-optic engineering parameters determined in Phase I will be utilized to build a fully operable prototype system which satisfies the specifications outlined in the topic description.

A90-090 TITLE: A Device for Direct Measurement of Penetration in Steel Plates

OBJECTIVE: Demonstration and delivery of a portable device capable of being used on an outdoors test range which could measure penetration depths in steel plates with an accuracy of + or – 1 millimeter. The ability to measure hole volume as well would be an attractive additional capability.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: There exists a need for a device, which will allow the measurement of penetration depths into steel plates. The device should e hand-portable and capable of being used on a test range. Accuracy required is generally + or – 1 millimeter.

There are complicating factors, which must be considered. First, there is generally some penetrator left in the hole. Consequently, a direct measurement is not always possible. Some of the penetrator material is classified as hazardous; drilling through it may not be feasible. The plates are not always flat after testing. Use of ultrasonic devices, as has been suggested in the past, might be difficult.

Currently, the steel plates must be torched and cut with a band saw to provide an accurate measurement of holds depths. X –ray facilities are also used to provide quick answers; however, this method is not as accurate as desired. There is a continual backlog of stored target plates awaiting measurement. Data must be obtained in a timely manner.

The requirement is to have these measurements done immediately after testing so that the plate may be disposed of, if necessary. Plates should not have to be cut in order to make the measurement.

PHASE I: The feasibility study should address all of the complication factors in making the desired measurement at the accuracy level stated. A method or device should be proposed which is capable of filing all of the requirements.

PHASE II: There should be a fully operational prototype device delivered for taking the type of measurement described above.

A90-091 TITLE: Firepower Allocation Methods

OBJECTIVE: Develop an Appropriate Algorithm to Analyze Complex Data Conforming Fire Direction Officers.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Investigate the potential uses of Case Based Reasoning (CBR) for determining the allocation methods(s) used by Fire Direction Officers (FDO) for allocation of firepower on enemy units.

The data will be provided by BRL. One data set contains 3000 tactical fire control decisions, and another data set contains 500 decisions. Each data item is an 18 element vector which includes the following: FDO, target type, target size, target range, type of fire mission, ammunition available, allocation method chosen, total number of rounds fired, type and number of first munitions fired, type and number of second munitions fired.

Several parametric and nonparametric statistical procedures have been applied to the data, but these have not been successful. This is probably because of the following unusual prosperities of the data: nonstandard structure, mixture of data types, nonhomogeneous variable relationships, and different degrees of influence of the variables relationships, and different degrees of influence of the variables.

PHASE I: Initial efforts will require data formatting and establishment of various schemes to evaluate the data. Preliminary analysis of the proposed methodologies to establish feasibility is required.

PHASE II: Full analysis of all data and delivery of decision methods to be used by FDOs is expected.

Army Research Office

A90-092 TITLE: Signal Design, Error-Control Coding, and Robust Stochastic Processing for Signals in Noise and Interference

OBJECTIVE: Develop new processing methods and architectures for Army tactical ground radio communications systems.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: The Army ground radio network of the future is likely to be a spread spectrum, packet radio network. New robust processing methods and architectures are required for these Army tactical ground radio systems. Army signals are wideband (spectrum spectrum), utilize coding with random characteristics, are highly mobile creating complex channel propagation characteristics, and encounter strong interference (jamming). Research is sought to define performance metrics and stochastic signal processing to reduce error probability, increase throughput, and reduce delay. Some specific topics for research include extraction and use of side information, error control coding/decoding, rapid acquisition/synchronization (especially in the presence of interference), theory and methods for identification and extraction of signal features and modulation characterization, and interference suppression and excision.

PHASE I: The goal of Phase I is to identify techniques for the identification and extraction of desired signal feature from broad based signals under conditions of intense interference (jamming).

PHASE II: The goal of Phase II is to demonstrate robust, processing methods and system architectures for extraction of data and error control of broadband signals.

A90-093 TITLE: Optical Techniques for the Control and Data Processing of Microwave and Millimeter Arrays

OBJECTIVE: Elucidate, define and apply principles and techniques for improved performance of microwave and millimeter wave arrays with reduced cost through the use of optical signal distribution and data processing.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: Active microwave and millimeter wave arrays require distribution of signals over long distances in terms of the system wavelength with very precise control of amplitude and phase. This requirement leads to systems requiring tight dimensional tolerance and resulting high cost. Optical LASERS can be modulated and/or combined n a non-linear device to generate the microwave/millimeter-wave signal with the proper phase relationship required fro each element of the array. These optical signals may be distributed to the array elements via single mode optical fibers. Processing of the received signal may also be processed in the optical domain thought eh application of wave front processing techniques. Innovative techniques and approaches are needed to realize the potential of such architectures at low cost. Of special interest are innovations associated with optical micro-wave/millimeter-wave interfaces and in wave front processing techniques. This research addresses specific aspects of goal described in the DoD Critical Technologies Plan topic “Phased Arrays”.

PHASE I: The goal of Phase I will be to establish the feasibility of signal distribution, control, and beam forming for phased arrays using optical techniques for both transmission and reception.

PHASE II: The goal of Phase II will be to demonstrate, in hardware, optical techniques for phased array systems and to demonstrate the viability of optical wave front processing for reception.

A90-094 TITLE: Methods for Reaction Front Measurements

OBJECTIVE: To develop new, innovative methods for measurement of temperature, pressure and chemical species concentration in the reaction front of solid propellants subjected to impact loading.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: Solid energetic materials (gun and rocket propellants) are believed to form localized shear bands under high rate impact. Hot spots, formed within the shear bands, are considered to be the sites responsible for

ignition of the martial under impact loading. The modeling of this ignition process and thus, the prediction of material response to impact, is quite uncertain due to lack of knowledge about the formation the hot spots and the dynamics of ignition and subsequent combustion due to them. At present, the overall mechanism is inferred based on observed material response to impact and hydro code calculations of material deformation. What is needed are direct measurements of local temperature, pressure and chemical species concentrations within the deforming, reacting shear band, with the spatial and temporal resolution necessary to resolve the hot spot dynamics. The extremely small size (sub micron), short time scale (sub microsecond), and random location within the deforming shear band are factors, which must be considered at attempting the measurements.

PHASE I: Formulation of experimental method to be used to measure shear band properties. Theoretical analysis of the proposed method, demonstrating the limits of spatial and temporal resolution, species to be determined, accuracy of the species concentration measurement, and accuracy of the temperature and pressure measurements. Analysis of the applicability of the proposed experimental method to measurements of shear band properties and hot spots n a composite, energetic material subjected to high rate impact. The analysis should clearly demonstrate the strengths and weaknesses of the method and identify technical risks.

PHASE II: Demonstration of the ability of the experimental technique to obtain precise data on the dynamics and reactions in an impacted energetic material. This will necessitate the construction of appropriate facilities and instrumentation to perform measurements on energetic materials, the conduct of appropriate experiments to demonstrate the range of applicability of the technique, and the analysis and interpretation of the results.

A90-095 TITLE: Concentration Fluctuation Measurements in the Atmospheric Boundary Layer

OBJECTIVE: Develop the instrumentation to measure, in a wide range of local meteorological environments, the mean and fluctuating concentration of tracer material in a small (point) volume to distance of 5 km from a source and demonstrate its capabilities in a trial field program.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: Measurement of inert tracer concentrations form controlled released is a fundamental way to study the dispersive effects of atmospheric turbulence. A fundamental barrier to a proper field experiment is the lack of a small, inexpensive, stable, fast response (5 to 10 Hz) device for point measurements of a specific tracer at low concentrations.

Innovative ideas for making highly sensitive, portable, rugged, and fast response devices for measuring tracer gases suitable for atmospheric testing are needed. Such devices would be used in field trials to determine the instantaneous (0.1 to 0.5 second average) of tracer materials at a large number (approximately 100) of fixed locations near the ground and mounted on masts to heights of 30 metes. The devices must be amenable to field calibration hold their calibration during trials lasting least 90 minutes. The devices should minimally disturb the airflow containing the tracer material.

PHASE I: A prototype sensing device meeting the above criteria should be assembled, calibrated, and tested in laboratory conditions.

PHASE II: Using several prototype instruments, a successful field demonstration of the devices should be accomplished.

A90-096 TITLE: Application of Ion-Induced Disordering to the Fabrication of Novel and Ultrasmall Electronic Structures

OBJECTIVE: Provide a theoretical description on ion-induced disordering and apply new methods for controlling ion-induced disordering to realize greatly improved performance characteristics for electronic structures.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: Ion-induced disordering of super lattices of GaAs and other compound-semiconductors may be used to mix adjacent super lattice materials back into a single bulk compound-semiconductor. Innovative techniques and approaches as well as a more complete theoretical understanding of the disordering process are required to realize the design and fabrication of novel ultra fast electronic devices. Of special interest are disordering techniques suited for the fabrication of quantum-based electronic devices capable of operating at room temperature. Research conducted during the execution of this task addresses specific aspects of goals described in the DoD critical Technologies Plan, "Preparation of GaAs and other Compound Semi-Conductors".

PHASE I: Define compositions and structures of super lattices to be disordered and identify ions to be used in ion-induced disordering: test the feasibility of such compositions.

PHASE II: Demonstrate ion-induced disordering in unique super lattice structures designed for use in high-performance electronic or opt electronic structures.

A90-097 TITLE: Low-Cost High Performance High-Electron-Mobility Transistors

OBJECTIVE: Elucidate, define and apply principles and techniques underlying the improved performance and reduced cost of high-electronic-mobility transistors.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: Two-dimensional electron gases formed at the interfaces between two different compound-semiconductor structures exhibit very high motilities and are suited for applications in high-speed electronics. Innovative techniques and approaches are needed to realize high-electron – mobility transistors with low cost, high switching speed, and low noise. Of special interest are innovations associated with greatly improved processing and fabrication techniques as well as novel designs and concepts for high-electron-mobility structures. Research conducted in this task addresses specific aspects of goals described in the DoD Critical Technologies Plan, "Microelectronics Circuits and Their Fabrication".

PHASE I: Define and test the feasibility of techniques for achieving high-electron-mobility structures with higher mobility and reduced noise levels.

PHASE II: Fabricated and characterize novel heterojunction-based high-electron-mobility structures and demonstrate higher mobility and reduce noise.

A90-098 TITLE: Computational Methodology for Finned Missiles and Guided Projectiles

OBJECTIVE: To develop a computer code capable of accurate prediction of the flow field around modern finned missiles and guided projectiles.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: The prediction of the transonic or supersonic flow-field in the vicinity of the fins on modern fin-stabilized missiles and guided projectiles is currently relatively inaccurate, and may be improved by the application of advanced grid generation schemes and zonal solution methodologies. This problem is complicated by the possibility of multiple fin sets, irregular fin geometries with crude aerodynamic shapes, and large attack angles. Additionally, fin deflection can cause a significant gap between the inner fin edge and the body surface; at supersonic speeds this gap can cause substantial interference effects and reduce the fin effectiveness, possibly due to shock wave formation within the gap and the interaction of these shock waves to include separation on the body. Analysis tools are required to accurately predict this three-dimensional flow field, as well as the resultant fore on the fins. Augmentation of these tasks by various experimental studies for verification of these concepts and the generation and/or use of benchmark experimental results for calibration of generated software might also be considered.

PHASE I: The basic research activity of Phase I should include a feasibility demonstration and assessment of the potential of the technique for future exploratory development.

PHASE II: The Phase II development goal is the validation of the technique against available experimental data. By the end of Phase II the technique should be developed to the extent that transition to advanced programs can be considered.

A90-099 TITLE: Adaptive Antennas Processing

OBJECTIVE: Perform research to provide technology for adaptive antenna arrays and processing for Army tactical ground radio communications.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: Army tactical radio systems operate in an environment of strong and complex interference. Adaptive antennas have the potential to provide 20-30 db gain. However the system must have the ability to converge rapidly in the presence of worst-case counter measures and must be small since Army communications terminals need to be mobile. Research is also needed on the operation of such antennas in wideband systems such as spread spectrum, frequency hopping and direct sequence. Techniques must also be found for the utilization and integration of adaptive antennas in Army networks.

PHASE I: The goal of Phase I is to demonstrate the feasibility of small adaptive antennas under conditions of high interference (jamming).

PHASE II: The goal of Phase II is to demonstrate hardware implementation of small adaptive antennas.

Atmospheric Science Laboratory

A90-100 TITLE: Nowcasting Temperature Inversions

OBJECTIVE: Develop a technique for estimating the occurrence of temperature inversions, especially elevated inversions, without resort to radiosonde observation.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Ground-based microwave temperature profiling is promising technique for obtaining covert, automated, real-time profiles of atmospheric temperature. There is a need for improving the prediction and characterization of elevated temperature inversions.

PHASE I: Develop a technique, which yields the strength, thickness, and base height of elevated inversions

PHASE II: Refine the nowcasting technique and provide real-time demonstrations for evaluation.

A90-101 TITLE: Optical Device to measure Aerosol Densities

OBJECTIVE: Development of a compact inexpensive to characterize battlefield aerosol distribution for possible use in predicting weapon system performance.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: There is a need for an inexpensive sensor, which can be deployed in arrays for the purpose of producing distribution profiles of natural and countermeasure aerosol clouds on the battlefield.

PHASE I: Develop a device to measure aerosol densities through the illumination of an external volume of air and measurement of scattered light.

PHASE II: Evaluation and testing of a prototype device with a variety of aerosols in a controlled environment.

A90-102 TITLE: Atmospheric Mesoscale Precipitation and Cloud Model

OBJECTIVE: Development of a mesoscale hydrometeor model which includes fog and haze with prognostic capabilities for tactical battlefield applications

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: There is a need for a simple multi-level prognostic cloud and precipitation model, which can be utilized on the battlefield as a tactical Decision Aid. The model should be capable of producing meaningful results from a minimum of observed parameters.

PHASE I: Develop an algorithm with the capability to analyze and predict cloud cover, ceiling heights, and the products of condensation or summation that are classified as hydrometeors.

PHASE II: Evaluation and testing of a prototype code using a variety of input observations to determine the optimum type of parameters to produce meaningful forecasts.

A90-103 TITLE: Modeling Atmospheric Effects on Thermal Clutter

OBJECTIVE: Development of a computer model which may be use to characterize the amount of thermal clutter I a scene viewed by a thermal imager and how the clutter level changes with changing atmospheric conditions.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: There is a need for an engineering grade computer model for atmospheric effects on thermal clutter for use in target acquisition models, which are being developed as tactical decision aids.

PHASE I: Develop a computer model which may be used to characterize the amount of thermal clutter in a scene as viewed by a thermal imager. The model should be conservative in usage of computer time and space and should use standard meteorological parameters as input.

PHASE II: Evaluate the validity of the clutter model developed in Phase I by comparisons with field data.

Electronic Technology and Devices Laboratory

A90-104 TITLE: High Energy Density Dielectric Materials

OBJECTIVE: Develop materials with high dielectric constant; low dielectric loss; and high dielectric strength for pulse power applications.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Some future Army missions will require high pulse power with pulse width from several microseconds to hundreds of nanoseconds and pulse voltage exceeding 5 kV/mil. The desirable density will be from 5 to 11 kJ/kg.

This requires materials with properties aforementioned in the objective. Polymers are preferred for their mechanical strength and ease of fabrication. In this category, poly (vinylidene fluoride) (PVDF) is best known for its high dielectric constant decreases. However, at higher frequencies, PVDF's dielectric constant decreases rapidly. This makes PVDF less desirable for fast pulse applications. We need develop new materials. There are many ways to control the dielectric behavior of polymers. The most important one is manipulation the chemical structure.

This program calls for the fabrication of new polymer materials. These materials should consist of novel structure and new composition to achieve high dielectric constant, low dielectric loss and high dielectric strength over a wide range of frequencies.

PHASE I: Preparation of candidate polymer materials based on theoretical considerations. Preliminary evaluation of dielectric properties using laboratory samples.

PHASE II: In-depth examination of dielectric properties of several of the more promising materials resulting from Phase I. Construction and characterization of laboratory capacitors or pulse forming lines to demonstrate at least one new material.

A90-105 TITLE: 10 Micron Infrared Phototransistor

OBJECTIVE: Design and develop a sensitive, low noise and high-speed 10 micron infrared detector based on GaAs/A1Ga AS material

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Recently, 10-micron infrared photoconductor have been successfully fabricated using GaAS/A1GaAS material system instead of the more conventional HgCdTe material. The advantage of this technological innovation is substantial. The new devices are cheaper, faster, more reliable and flexible, and easier to integrate to the supporting electronic circuits. However, the present sensitivity of these devices tends to be lower due to the larger associated noise. This project is to develop a new transistor-type of structure based on the same material to lower the noise level and hence increase the sensitivity of the device.

PHASE I: Phase I is to design the basic transistor structures and study the transport properties of the photo excited hot electrons in these structures.

PHASE II: After a better understanding of the dynamics of the hot electrons is established, optimize, fabricate, and test the device structure to achieve the minimum noise level and maximum sensitivity of the devices.

A90-106 TITLE: Integrated Circuit Device Packing Protection Against High Power Microwave Directed Energy Weapons

OBJECTIVE: Study and investigate packing and interconnection techniques to protect digital integrated circuits against high power microwave directed energy weapons.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Advanced VLSI/VHSIC digital devices using bipolar and CMOS technology are highly susceptible to upset and damage do to high power microwave (HPM) energy incident upon the chip or multi chip package. The digital devices utilize sub-micro feature size technology; operate at clock rates of 100 mhz and logic levels of 3.3 volts. These deceives are intended for use in advanced DoD electronic systems and must be protected against HPM energy, whether form friendly or enemy sources. New and innovative techniques for signal and power/ground interconnections, coupled with reliable packaging, are needed to solve the GPM energy problem.

PHASE I: Phase I should result in a technical report covering a study and investigation of alternative packaging and interconnection methods and techniques to protect digital integrated circuits form upset an damage due to high power microwave energy. Emphasis should be placed on packaging/interconnection technology and materials resistant to radiated and conducted microwave energy.

PHASE II: Phase II should result in experimental packaging and interconnection techniques and demonstration circuitry to show proof of principle for the chip and multichip protection against HPM. Testing and evaluation in a HPM environment should be included.

A90-107 TITLE: Multi-Beam Phased Array Sensor for Tank Defense

OBJECTIVE: An investigatory and development effort directed towards the development of multi-beam high resolution phased array sensor for the detection and tracking of low flying and fast moving small multiple targets at moderate ranges.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Development of new sensor techniques for tank defense, target acquisition, and precision guided munitions are urgently needed to overcome the inherent limitations of existing technology and to improve systems performance and reliability. Phase array techniques incorporating the latest advances in solid-state devices should be utilized in this development. Proposed sensor application should be incorporate spread

spectrum techniques, have capability of fast acquisition and tracking of multiple targets and high angular resolution.

PHASE I: Analyze circuit techniques needed to identify low flying and fast moving multiple target as well as provide spatial resolution of individual reflectors on armored vehicles. Demonstrate functional feasibility of the circuit techniques studied.

PHASE II: Refine the techniques studies under Phase I and develop a functional multi-beam phased array sensor.

A90-108 TITLE: High-Temperature Superconductor Devices

OBJECTIVE: To identify and develop active and passive high-temperature super conducting devices having a potential impact in future high-technology Army areas.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: This effect will assess the feasibility of utilizing recently develop high-temperature superconductors in a variety of devices suitable for use in present and proposed Army systems. This will be done by targeting one or more devices for design, fabrication and evaluation. The proposed effort must address one or more of the following classes of devices:

a. High-Q radio frequency structures (in the 1-40 GHz range)
b. Hybrid semiconductor (e.g.GaAs HEMT's) – superconductor devices for ultra-high speed, high-frequency information processing
c. Sensors and detectors for:
    i. Infrared
    ii. Micro/millimeter waves
    iii. Magnetic fields

PHASE I: It is expected that by the start of the Phase I effort, much of the material properties of the high-temperature superconductors will be relatively well understood. As such, this phase will be connected with device design, prototype fabrication (possibly by several of the established techniques), and prototype device evaluation. A simple proof-of-concept demonstration is required.

PHASE II: For the Phase effort, fabrication techniques and processing should be optimized for best yield, overall properties and device-to-device uniformity. An operable prototype system incorporating the super conducting device(s) is to be fabricated, tested and evaluated as to the advantages and feasibility of using it in a fielded system.

A90-109 TITLE: Monolithic Microwave-Acoustic Devices

OBJECTIVE: Investigations leading to the development of high performance, monolithic, thin film acoustic resonator filters and oscillators operating at microwave frequencies.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: This study will guide technology and device developments providing a broad class of microwave frequency source and/or frequency selective devices, synergistic with MIMIC modules, directed toward applications previously precluded by size, weight and cost considerations. Developments will ultimately lead to

a family of building blocks providing monolithically packaged functions, e.g. receiver front ends, frequency source and/or frequency selective devices, synergistic with MIMIC modules, directed toward applications previously precluded by size, weight and cost considerations. Developments will ultimately lead to a family of building blocks providing monolithically packaged functions, e.g. receiver front ends, frequency source/transmitter, etc.

PHASE I: Should result in a technical report providing major architectural innovations; high level of active and passive circuit integration with monolithic film resonators. Simple proof-of-concept demonstration models of select functions are desirable.

PHASE II: Detailed technology development of piezoelectric thin-film resonators integrated with active and passive circuit components. Implementation of necessary processing operations to obtain brass board models of advanced concept chips and modules exhibiting specific functions. Performance demonstration of packaged devices, including test data and delivery of representative samples will be required at the conclusion of the program.

A90-110 TITLE: RF Circuit Testability and Built-In Test Approaches

OBJECTIVE: To examine and develop new techniques for Testable Design. Testability Analysis and Built-In Test for RF circuits.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: While testability analysis, design for testability and testing methodologies have been explored substantially for digital circuits, considerably less effort has been put forth in those areas for analog circuits, particularly those operating in the RF range. The non-deterministic nature of testability analysis and testing methods for RF circuitry, as well as the peculiar failure modes and operational sensitivities have precluded such progress in this area. This project explores new methodologies and techniques for testability analyst and Built-In-Test (BIT) approaches for RF applications. This project should not require an initial linier model assumption. The testability approaches examined should include built-in-self test (BIST) techniques

PHASE I: Phase I should result in a technical report that explores different BIT, BIST techniques that can be used in RF circuit applications. Simple demonstrations of the effectiveness of these techniques should also be presented.

PHASE II: Phase II should result in the application of a subset the techniques investigated in Phase I. In this Phase, an example RF subsystem should be designed so that it is self-testing.

A90-111 TITLE: Nanoelectrics

OBJECTIVE: Develop futuristic device concepts and consider conceptual issues in the ultimate formulation of the device properties (modeling and device simulation, concepts, etc) relevant to molecular-size electronics.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: As semiconductor technology continues to pursue the scaling down of IC device dimension into sub micron (less than ten thousand angstroms) region, may new and interesting questions will emerge concerning the physics of microelectronics. Some of the more important topics to be considered include no equilibrium transport (ballistic transport, overshoot phenomena, quantum transport, etc.), quantization effects arising form geometrical size constraints, proximity effects resulting from closely packed arrays of devices, and

general solid-state considerations not heretofore considered questionable (effective mass approximation, the role of contacts, material and processing issues, and the like). Moreover, form the point of view of device physics; it is more desirable to have microscopic description of physics in small dimensions, which is at least amenable to phenomenological treatment so that its properties can be meaningful incorporated into futuristic device concepts and simulations.

PHASE I: Identify novel concepts, issues, and technology barriers to be overcome in the formulation of molecular-sized functional structures designed to sense electromagnetic signals, pre-process and process information with relatively high throughput, and lend itself to integration with high-powered computational tools.

PHASE II: Overcome the technology barriers identified in Phase I; assemble and implement an achievable functional prototype to demonstrate proof-of-principle and/or feasibility.

A90-112 TITLE: Microwave Plasma Deposition of Refractory Materials for Performance Electronic Devices

OBJECTIVE: Investigate microwave assisted plasma deposition process and develop the associated materials technology to grow semiconductor grade refractories suitable for high performance electronic devices.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: An area of intense interest which has not been fully exploited is microwave assisted plasma deposition of high purity, high quality refractory compounds. This investigation will assess the feasibility of using microwave assisted plasma deposition (MAPD) techniques to produce refractory semiconductors and dielectrics (e.g. diamond; silicon oxide) for use in high performance electronic devices.

PHASE I: All of the parameters requisite to the microwave assisted deposition of high quality refractory semiconductors and dielectrics at low temperatures are not fully understood nor well defined. Phase I will study and derive optimized MAPD techniques and will result in the preliminary design of a basic deposition system for the growth of these materials.

PHASE II: After a more complete understanding of the MAPD parameters for refractory semiconductors and dielectrics is derived, a finalized deposition system design will be executed. An operable prototype system, incorporating an optimized chamber for microwave plasma assisted growth, is to be fabricated, tested and evaluated.

A90-113 TITLE: Microcircuit Reliability Temperature Dependency

OBJECTIVE: To reduce size weight and cost of Army equipment though reduced cooling requirements.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Historically, silicon microelectronic device reliability as a function of temperature has been assumed to follow an exponential failure rate. The model most used is the Arrheius equation of $R=R_o \exp(-EA/KT)$. Device degradation occurs as a function of temperature through a chemical reaction within the devices package, on the device surface and within its bulk. Accelerated stress tests are usually performed to determine EA, which is ten used to extrapolate to equipment use conditions. With today's ultra clean process, assembly and packing environments, doubt is raised regarding the validity of a chemical reaction at the temperatures anticipated for system operation. If temperature dependence is not a reliability factor, then the

tremendous burden imposed by additional cooling for electronic systems within helicopters, tanks, and wheeled vehicles could be reduced from active to only passive cooling.

PHASE I: A technical report will include the development of a model to explain present microcircuit reliability in the temperature range of –55°C to 125°C. All failure mechanisms will be addressed.

PHASE II: Validation of the model will be presented in a final report. Test structures could be used as vehicles to study and verify temperature independence.

Human Engineering Laboratory

A90-114 TITLE: Artificial Intelligence (AI) Applications to Tactical Logistics

OBJECTIVE: Exploratory and advanced development efforts in the application of artificial intelligence (AI) technologies to tactical logistics planning, scheduling, and maintenance. The objective is to explore innovative, knowledge-based approaches to well constrained and focused military logistics applications, including a serious effort at knowledge acquisition and prototype development.

CATEGORY: Exploratory/Advanced Development

DESCRIPTION:

GENERAL: Tactical logistics planning is complex and dynamic, often exceeding the cognitive limits of experts and the computational limits of algorithmic solutions. Presently, Army tactical logistics planners manually generate logistics plans in response to tactical scenarios, taking significant man-hours and making it impossible to react to real-time planning contingencies. AI based decision support items will enhance the prediction of resupply requirements, allocation of transportation assets. AI based decision support items will enhance the prediction of resupply requirements, allocation of transportation assets, the rapid evaluation of alternative logistics support plans, the distribution and maintenance activities, and the determination of stockage, repair and distribution policies. Specific areas of interest are:

a. Intelligent adaptive, multimedia interfaces to knowledge – based systems which justify result, explain effects of “what if” changes, infer appropriate actions/answers, correct imperfect queries & resolve understandings.
b. Knowledge-based decision support environment for log planning such as resource allocation, planning & replanning a course of action, & configuration of facilities. Develop techniques to resolve goal conflicts, exploit constraints, & reactively replane with minimal plan disruption.
c. General software architecture for diagnosing mechanical & electrical failures, which can be customized with domain-specific knowledge bases. Reasoning for multiple flaws, direct sensor feeds, repair-plan formulation, prognostics, on-line documentation, & knowledge-base integrity control.
d. Robust learning techniques (genetic algorithms, neural nets) capable of adjusting uncertainty parameters performance data is received, updating knowledge basis, & detecting new patterns from accumulated experiences
e. Knowledge-based aid for simulation modeling which manages simulation inputs analyzes results & acts anomalies in simulation runs. Resulting system shall have the ability to generate scenarios, help build the simulation model, interactively suggest particular strategies & answer “what if” questions.

PHASE I – Emphasis should be on innovative knowledge-based approaches (including a rich knowledge representations scheme and advanced control structures) to well constrained and focused military logistics applications. The work should include a serious effort at knowledge acquisition (bidders must possess or obtain tactical logistics expertise) and prototype development (bidders must have their own computing facility).

PHASE II: Emphasis should be on development and field evaluation of full operational prototype demonstrating the increased effectiveness and added capabilities made possible by the technology.

A90-115 TITLE: T-handle Side-arm Control for Combat Vehicles

OBJECTIVE: Design and develop a single control to be operated by one hand, which will control the direction, maneuverability of an armored vehicle.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: A system must be developed to allow control of combat vehicles with one hand leaving the other hand free to perform required tasks (or permitting a wounded tanker to maintain control with one hand). The T-handle is a natural approach. Advancing the T-handle forward from a neutral point would engage the vehicle in a forward gear and add power, retarding the lever would slow it down. Bringing the lever back through the neutral point would engage reverse gear and add power as the lever is retarded further. Turns would be made by twisting the T-bar in the desired direction; applying left twist would result in a "locked-track" pivot. Some buttons and auxiliary controls could be added to the T-handle, but it should not be cluttered

PHASE I: Design and develop the T-handle controller and conduct static testing on vehicles on blocks. Locate the T-handle on the driver's station armrest and provide height adjustment and friction control to accommodate personal preferences. Consider provisions to permit either left handed or right handed operation.

PHASE II: Install T-handle controller in a test bed vehicle (GFE) and conduct driving tests over a variety of conditions and using a range of driver experience. Incorporate thumb-operated ICS/RTO switch on the T-handle and evaluate locations appropriate for the other handle-mounted controls.

A90-116 TITLE: Compact Robotic Command Center Simulator

OBJECTIVE: Using off-the-shelf, commercially available computer equipment, construct a portable test and evaluation capability for robotics command and control interfaces. Phase III system would be capable of emulating existing or proposed robotics operator interfaces and conducting human engineering test under field conditions at remote sites, permitting the Army to take proposed interface designs out to the troops for testing prior to finial design freeze for the systems

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Development of this would permit the designers of soldier robotic system interfaces to mock up, test, evaluate and modify proposed interface designs using real-time input from the soldier community. This capability would cut months form the design and testing schedule for robotic systems, permit the early evaluation of systems prior to actual hardware procurement, and reduce initial interface evaluation cost and could significantly impact final overall system training costs.

PHASE I: Procure basic equipment and write initial test and evaluation programs. Run limited static and (if possible) dynamic demonstrations to determine optimal configuration for finial test system design. Evaluate possible use of interface prototyping programs such as LABVIEW for incorporation into the finial design Provide finial system requirements and desired performance parameters. Generate draft requirements, circulate for comment and incorporate comments into final Phase II design.

PHASE II: Procure finial equipment and, using designs from the TACOM Robotic Command Center program and the HEL TEAM program, construct detailed interface layouts and test scenarios. Conduct pilot studies and refine software/hardware interaction. Develop finial full specifications for Phase III test and evaluation capability.

A90-117 TITLE: Combat Vehicle Tactical Display System (TDS)

OBJECTIVE: Design and develop a tactical display system for use in armored vehicles, which would show terrain features as well as detected threats and force disposition. Display would be set-up during pre-mission planning, and would be automatically update via data link as new threats are discovered and battle lines shift.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: A multifunction display (MFD) will be used by the vehicle commander to keep track of his position and the location of other friendly and hostile forces. For instance, an enemy emplacement and its effective field of fire could be displayed and the commander could modify his route to minimize exposure. Likewise, the warning of a chemical attack showing the origin and the download "footprint" could be transmitted to the vehicles in the field and used to avoid or minimize contract. Downlink could be from satellite or unmanned flying vehicle using secure burst communication.

PHASE I: Design and develop and MFD for use in an armored vehicle. Develop software interface to permit insertion and overlay of symbols on a contour map presentation. Initial map area may be large-scale and stationary, with grown potential to moving-map display capability. Include a menu of standard military symbols and development symbology for depicting nuclear/biological/chemical "footprint".

PHASE II: Demonstrate the capability to update remote tactical displays from a compound center. For instance, information on a hostile troop concentration could be broadcast and appear immediate on the MFD's of all vehicles in the vicinity. The same system could be used to indicate the desired location of maneuver elements.

A90-118 TITLE: Visual Transition Enhancement

OBJECTIVE: Investigate the perceptual problem with making frequent and rapid transitions between external and internal environments, and develop cueing systems to reduce problems and enhance performance.

CATEGORY: Basic Research/Exploratory Development

DESCRIPTION:

GENERAL: Currently, combat vehicle crewmen must transition form external world to the limited view; presented through periscope vision blocks when he seal himself inside the vehicle. In future combat vehicle systems, the internal view will consist of virtual images presented on cathode ray tubes (CRTs) or similar visual displays. The crew must be able to transition frequently and rapidly between these "real" and virtual' presentations while remaining oriented to external threats and landmarks.

PHASE I: Qualify the nature and extent of crewman disorientation, and the resulting reduction reductions if combat effective associate with internal/external visual transitions. In particular, consider the effects of low light and obscurants. Investigate visual cueing systems and other means to smooth the transitions and improve performance/survivability.

PHASE II: Design and develop prototype hardware based upon the previous work, and demonstrate the system effectiveness compared with present systems under identical circumstances. Evaluate under simulated threat conditions such as found at the National Training Center.

A90-119 TITLE: Combat Vehicle Crewman (CVC) seat

OBJECTIVE: Using fire-resistant materials, design and develop crew seats which will stabilize and protect the user while traveling at high speeds over rough terrain. Sitting posture should be adjustable from upright through fully reclined.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: When traversing rough terrain at high speeds, crewmen have difficulty controlling weapons and sensor systems because of the shock loads transmitted to them through the existing seats. Furthermore, during extended periods of operation, the ability to rest in place at the combat crew station is reduced because of seat discomfort and limited adjustability.

PHASE I: Design several seat configurations which could be installed in present or future vehicles, and which would reduce chassis-generated shock loads to the soldier and provide a greater degree of adjustability and comfort.

PHASE II: From the various design approaches, select one for fabrication. The delivered product would be tested by the government, refined if necessary, and eventually installed in a combat vehicle for user evaluation in field settings.

A90-120 TITLE: Soldier Compatible Air Defense Display

OBJECTIVE: Identify, prioritize and produce prototype displays and software. These displays must be compatible with forward area air defense command and control applications.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: The utility of displays as a means of conveying air defense information needs to be optimized. This research will examine display hardware/software techniques to ensure good information transfer in the time constrained air defense environment.

PHASE I: Identify and prioritize the types of displays and the software (human/computer) interfaces that are most effective in forward area air defense intelligence preplanned produce improvement applications. The display characteristics and tradeoffs at each node (forward area air defense command, control and intelligence subsystem) must be categorized.

PHASE II: Fabricate candidate display systems at fire unit, platoon, battery and battalion for forward area air defense applications. Demonstrate the effectiveness of these displays in a laboratory experiment. Validate results with field test using Army air defense personnel.

Harry Diamond Laboratories

A90-121 TITLE: Tactical Terrain Reasoning System

OBJECTIVE: It is anticipated that a successful project would be incorporated into combat information processing and robotic equipment. The objective of the SBIR effort is to develop, integrate, and demonstrate a real time Tactical Terrain Reasoning System (TTRS).

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: There is a large amount of applicable research ongoing in the areas of tracking algorithms, spatial reasoning and expert system tools, object-oriented data bases, and military doctrinal knowledge that exist within government, industry, and academia. There is a need to optimize and integrate appropriate technologies into an effective system oriented toward specific military problems. An example of such an application would be the requirement to predict the optimal place and time to interdict an advancing second echelon (sensed by a UAV based MTI RADAR) with artillery.

The ability for a system to continuously integrate the current battlefield situation with changing terrain and environmental conditions is a key factor for all five Army functional areas to assist the commander in effectively planning and executing current and future tactical missions. Terrain reasoning is a major factor in determining mobility, route locations, choke points; target areas of interest, sensor locations, fire power resource allocation, event detection, fuel consumption, logistical coordination, robotic equipment and many other time critical activities on the battlefield.

PHASE I: Conceptual/Preliminary Design Phase. Phase I will include a review of presently used technology that exists in the areas of terrain reasoning and tracking algorithms, spatial data bases, expert systems, and object-oriented data bases that exists in industry and academia, as well as the results of previous and ongoing government programs. The results of this study will be used to formulate a conceptual design document which addresses the high level hardware and software design of a TTRS in the form of block and dataflow diagrams describing algorithms as well as identification and discussion of the technology shortfalls.

PHASE II: Develop and demonstrate TTRS software in accordance with the detailed design performed during phase I. The software includes all man-machine interfaces, algorithms, and knowledge bases required to maintain operational capability of the TRS along with the software required to measure its performance. All software will be developed under the UNIX System V Release 3 on a 680xx based multi-processor system. Software will be written in one or more of the following languages C, C++, LISP, Prolog, ADA, a government approved expert system shell programming language. The ADA system will be demonstrated at Harry Diamond Labs on existing field demonstration hardware.

A90-122 TITLE: Performance of Multi-Layer Wide Band Patch Antennas

OBJECTIVE: Results of successful projects may be incorporated into fuze production programs. The object of this project is to demonstrate the feasibility of producing small multi-layer wide band microstrip patch antennas for an artillery proximity fuze application; emphasis on low cost fabrication techniques is required.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: A need exists for wide band (at least 10%) microstrip patch antennas for next generation artillery proximity fuzes. Innovative techniques have been explored to enhance the bandwidth of single microstrip radiators with encouraging success. However, due to the techniques used to increase bandwidth, potential difficulties in the fabrication and production of such antennas are anticipated. Currently bandwidth enhancement techniques use multi-layer substrates and proximity coupling to the primary radiating element for the increased bandwidth. Microstrip matching elements are also used at the feed point of the antenna. At higher microwave frequencies where process tolerances become important, registration of antenna features between the different layers of substrate are critical. Studies are needed to predict how well antenna performance will be maintained during fabrication and production of multi-layer wide band microstrip patch antennas, and whether, if required, economical means of tuning or trimming antennas could be employed.

PHASE I: Determination of suitable fabrication techniques and substrate materials for the development of wide band multi-layer microstrip patch antennas. Develop and validate methods to predict performance variations using the selected techniques and materials.

PHASE II: Developmental fabrication and testing of wide band multi-layer microstrip patch antennas using materials identified in Phase I. Demonstration of feasibility of achieving low cost production and a study to show expected cost vs. production rate.

A90-123 TITLE: Optical Interferometers for Sensing Electromagnetic Fields

OBJECTIVE: It is anticipated that a successful project would be incorporated into maintenance equipment for ensuring the survivability of critical Army mission equipment. The object of the project is to improve the accuracy of measuring wide band transient electromagnetic responses by using optical interferometer sensors which do not disturb the fields being measured.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: The accuracy of measuring wide band transient electromagnetic responses can be enhanced by using nonmetallic sensors which do not disturb the fields being measured. Sensors utilizing a waveguide Mach-Zehnder interferometer approach this desired dielectric sensor; however, they still require metallic contacts and antennas. The operation of these devices is based on the electro-optic characteristics of the crystal material used in the interferometer. A laser beam is divided into two channels within the interferometer. Metallic electrodes are then positioned at the appropriate locations on the waveguide channels so that when a voltage is applied to the contacts, the voltage across the two channels have opposite polarities. The resulting change in the index of refraction of the crystal delays the light in one channel with respect to the light in the adjacent channel, resulting in a net phase shift. When the light is recombined, a change in light intensity results due to the intensity results due to the interference of the two light waves. The interferometer can be operated such that the light intensity is proportional to the voltage across the crystal. The required electrodes and antennas, although very small, perturb the fields being measured and create frequency limitations due to their interactions with the electromagnetic fields.

PHASE I: Consists of investigating the possibility of creating and interferometer with the crystal material of the two waveguide channels oppositely poled. This would effectively eliminate the need for the metallic electrodes and their associated limitations. The interferometer should have a flat frequency response from DC to 1GHz with at least 40 dB dynamic range. Analyses and/or experimentation will be required to determine the feasibility of manufacturing such a device and its capability to perform to the required specifications. Emphasis may also be placed on miniaturization. The feasibility of calibrators should be addressed.

PHASE II: Consists of the actual manufacturing of a prototype interferometer electromagnetic field sensor system.

A90-124 TITLE: Automated Electronics Assembly and Test

OBJECTIVE: It is anticipated that successful projects would be used in the manufacturing process of military electronics. The objective is the development of new processes and innovative automated assembly equipment for electronics which will lead to reduced cost and/or higher quality and reliability of electronic systems, both military and commercial.

CATEGORY: Advanced Development

DESCRIPTION:

GENERAL: The scope of the project is to attack electronic assembly issues of national importance, the solution of which will have national economic consequences. This project includes all facets of the automated assembly of electronic sub-systems and the assembly of sub-systems into electronic systems. Examples of subject matter of interest are: solder joint theory, component-substratre joining, inspection of joints, new joint materials; innovative use of machine vision for assembly and test; robotics; new technology for inspection and test; extension of surface mount concepts for flexible manufacturing; advanced concepts; advancement of statistical process control, and the advancement of quality control theory.

PHASE I: Advanced development of the automated electronics assembly concept or process. Complete study short of building factory evaluation prototype.

PHASE II: Fabrication of working prototype capable of factory floor evaluation. Full technical data package containing all drawings and process information, complete operating manuals.

A90-125 TITLE: Guided-Wave TeO2 Optical Devices

OBJECTIVE: This exploratory development would provide a means of obtaining a more efficient optical modulation element to be use in acousto-optic (AO) signal processing devices both for laboratory application and for EW system applications such as radar threat warning receivers, SAR return processors, and geolocation devices.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Tellurium dioxide is an AO material having a high figure of merit which has been extensively used as a bulk acoustic wave (BAW) AO modulator; however, relatively little work has been done to make use of the high figure of merit in a surface acoustic wave (SAC) AO configuration. In addition, transducer power limitations impose restrictions on the usable dynamic range of BAW AO devices. Development in either or bother SAW and BAW AO devices will increase the speed and processing gain of optical processing system.

Acoustic-Optic SAW devices use a surface acoustic wave (SAW) to interact signals with an optical beam passing through the crystal. Generally, these devices are constructed using photolithographically produced interdigital finger transducers to excite an acoustic mode which is closely confined to the crystal surface; however, there have been other mechanisms used to create the SAW. An advantage afforded by the SAW AO device design is that multiple transducers may be laid on the surface of the crystal, the number of which is limited only by crystal “real estate,” and crosstalk among the SAW’s.

BAW devices have been used extensively in the development of AO signal processors where high speed and high processing gain are required. The requirements on these devices are that they must have a large spurious free dynamic range and large signal bandwidths. In order to operate in a spurious free region, the input power to the device must be at lower power levels. This puts a limitation on the dynamic range of the AO system unless methods are developed which will increase the efficiency of the BAW devices. Phases array transducer designs incorporated into the AO modulators can be used to increase operational bandwidth and efficiency of these devices.

PHASE I: Phase one would consist of the design of several breadboard TeO2 AO devices each having TBWP of preferably 1000 or better. They would be designed at several different center frequencies, affording bandwidths of roughly one-third their center frequency values. These would form the basis of designs for optical processing modules such as spectrum analyzers and correlators. The SAW devices would have at least two active, counterpropagating SAW’s supported in the active optical aperture. The BAW devices would have a device each having an optical aperture of 70 microsecods and bandwidths of at least 30 MHz and up to 60 MHz.

PHASE II: Phase two would consist of the development of prototype TeO2. SAW and/or BAW devices which could be incorporated into optical processing systems designed for such applications as radar threat warning receivers and optical signal and image correlators suitable for field testing in flying systems. Existing designs would be modified for insertion of these new devices which should increase the calculational capabilities of the optical signal processing system.

A90-126 TITLE: Acceleration Sensing Module for Munition Safety Systems

OBJECTIVE: The objective is to develop and test a miniature, low-cost acceleration sensing and integrating module for use in missile electronic safety and arming systems. Size is to be less than 0.03 cu-in and cost is to be about $15 ea in small quantities of about 100 units.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Most current munition fuzes use an acceleration-time sensor as a primary safety element. Present devices for missile and rocket fuzes are generally composed of bulky spring mass systems interfaced to mechanical escapement mechanisms used to "integrate" acceleration and give an output when a safe separation condition is reached. What is needed is a simple acceleration sensor and electronic processing module to substitute for these bulky mechanical devices in electronic safety systems. The problem with currently available accelerometer devices that might fit this need is that they are too expensive, and too large in size.

PHASE I: Detailed design, functional prototype, and a formal descriptive report are the desired output from Phase I. A generic requirement is for an acceleration-time sensing device functioning in the range of 2 to 40 g with a single integral or double integral or time output in the range of o., 05 to 6 seconds. Output need be accurate only to about + 10% and is to occur only if a factory present condition is exceeded. Electrical power (logic level on the order of 5 volts) would be supplied to the sensor and circuit from the fuze. Target size is evaluated on various factors to include: potential of design concept to meet size and cost targets, potential reliability, and flexibility of adapting a single design to a broad range of munition requirements.

PHASE II: Assuming that Phase I is successful, the most promising design will be developed by design refinement to enhance performance and producibility, building of one or more qualification lots, extensive testing for ruggedness and performance, and demonstration field testing. A data package and technical report will be prepared as required for proceeding to Phase III and as needed for integrating the device into various DoD munitions.

A90-127 TITLE: Electromagnetic Protectors for Microwave Circuitry

OBJECTIVE: The objective is to develop the technology needed to manufacture a family of protective devices based on saturation characteristics of ferrite or other materials capable of protecting microwave circuitry from damage from high levels of microwave energy. Phase III applications would involve incorporation into radar communications, and electronic warfare equipment.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: A protective device is needed to prevent damage to microwave circuitry when the risk of exposure to impinging high levels of microwave energy is present. At these frequencies, metal oxide varistors (MOV's) are not suitable because of their inherent capacitance. Semiconductor protectors present a design conflict because as the frequency is increased, the size becomes smaller with a corresponding reduction in power handling capabilities. Ferrite materials in an appropriate configuration present an alternative to these traditional approaches. Other potentially successful approaches are also sought. Ferrite materials exist and others can be

developed that have high losses to microwave fields as the material saturation point is exceeded. Microwave ferrite devices currently in use include phase shifters, isolators, circulators and other devices, but no saturation-based protection devices. This program is an investigation of methods of utilizing the characteristics of materials to create a family of protective devices for preventing damage to microwave systems exposed to high levels of electromagnetic energy. Types of protective device designs to be produced will include but are not limited to microstrip, stripline, rectangular waveguide, and circular waveguide. Integrability with gallium arsenide is desirable.

PHASE I: Technology survey, analysis, and demonstration. Phase I shall include a survey of existing technology pertaining to ferrite or other material loss characteristics at microwave frequencies, investigation of saturation properties, formulation of specific configurations for various transmission line types, analysis of the potential of each specific configuration, determination of design parameters, and a preliminary experimental demonstration of a microwave protective device. Types of device configuration to be pursued include but are not limited to microstrip, stripline, rectangular waveguide, and circular waveguide.

PHASE II: Development and testing. Phase II is the development of the specific configuration identified as having potential in phase I. Although the specific requirements as to which and how many designs to be pursued in phase II depend on the results of phase I, in general, phase II shall include the further development of specific designs at various frequencies, optimization of the material properties for use in protective devices, fabrication of small quantities each design, and testing of these devices.

A90-128 TITLE: Light Weight Electromagnetic Shielding Material

OBJECTIVE: Investigate and design a material electromagnetically shielding and enclosure. Successful materials would be fielded in lightweight Army tactical shelters.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Presently tactical shelters use 30 to 50 mil aluminum sheets to harden and to maintain structural rigidity. MIL-STD-907B stipulates 60 dB shielding effectiveness when tested in accordance with MIL-STD-285 procedure for DoD standard family of shelters if the shelter requires protection against EMI/EMP stress. It is highly desirable to build a shelter made with composite material to reduce tare weight, but a lightweight material is required to harden the shelter.

PHASE I: Investigate and design a low cost material to harden a shelter made with composite material. Provide the Government the detailed documentation including the material performance against the EMI/EMP threat, electrical property, composition of material and test data. Design Goals: a) At least –60dB of shielding effectiveness when tested in accordance with MIL-STD-285. b) Reduction of material weight by 80% or over 30 mil aluminum sheet. c) Low cost with respect to 50 mil aluminum sheets.

PHASE II: Design and fabricate an S280 (C) – type shelter utilizing the composite material developed in Phase I. The designs for this shelter are to meet the critical mechanical and structural specifications for a standard S280 (C) shelter as given in the S280 (C) Shelter Specification Document.

A90-129 TITLE: Ultra Wide Bandwidth Radar Components Development

OBJECTIVE: Is to develop devices that would allow construction of a coherent-on-receive UWB (ultra wide bandwidth) radar receiver.

CATEGORY: Basic Development

DESCRIPTION:

GENERAL: Functionally, what is needed could be supplied by an A/D (analog-to-digital) converter driven by a clock signal that is triggerable. Triggering that causes the clock zero crossings to become aligned to an asynchronous trigger pulse to within +/- ½ ps is desired. Clock stability of 10^-9 over 700 us period after triggering is desired. Also desired is a long term clock stability of 10^-9. A full-scale bandwidth of 2 GHz and 6-bits or more of accuracy is desired in the A/D converter.

A normal A/D converter accepts an input signal f(t) and provides a series of values at discrete time i.e. f(t0), f(t1), f(t2), f(t3). It would be advantageous for the A/D converter to function as an integrating converter. That is, it accepts an input signal f(t) and provides a series of values {f(t)dt between limits t0 to t1, t1 to t2, t2 to t3, and so forth. Proposals that identify technology applicable to implement the functions are solicited.

PHASE I: Develop Devices. Phase I will focus on demonstrating the feasibility of devices that would perform the described functions.

PHASE II: Develop a system. Phase II will focus on assembling a functional prototype.

Materials Technology Laboratory

A90-130 TITLE: Nondestructive Evaluation of Bond Quality

OBJECTIVE: Development of a new, efficient, nondestructive evaluation (NDE) system capable of determining the quality (strength) of bonds in adhesively joined structures both on the manufacturing floor and in the field. Potential phase III applications for the new NDE system include Army helicopter blades and panels, missile radomes and motor cases, projectiles, mines, fuel tanks, tank pads, and future combat vehicles; as well as commercial areas such as aircraft, helicopters, automotive, electronic, and construction.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Bond failure usually occurs interfacially and is usually due to poor adherend surface preparation and/or exposure to adverse environments. Conventional NDE techniques only permit a spot check of the bonding process. A lack of adequate NDE procedures and technology to determined bond quality had impeded the widespread use of adhesively bonded structures. Bond quality is defined as actual bond strength relative to the normal required bond strength of a given component as determined using NDT testing methods. Innovative approaches are needed for development of improved NDE methods to evaluate the quality of bonds. Since it is difficult to directly measure the bond strength nondestructively, it is necessary to infer bond strength from other properties such as bond areas, stiffness, bond thickness, and damping. Hence, in order to predict bond quality using NDE methods it is necessary to correlate bond strength with various other NDE technique properties as cited above.

PHASE I: Develop one or more novel NDE techniques and demonstrate that the concept involved can be effectively used to measure bond quality. Correlation of results with conventional destructive tests such as pull tests and tear tests will be required.

PHASE II: Optimize the most promising NDE technique(s) demonstrated in Phase I. Develop a Prototype NDE system along with any necessary auxiliary equipment and software to determine the quality of bonds in adhesively joined structures. The effectiveness of this system must be demonstrated on samples or specimen models typical of the potential Phase III Army applications cited in the “objective” above.

A90-131 TITLE: Novel Surface Treatments for Improved Adhesive Bonds

OBJECTIVE: To develop surface treatments for metals which modify their surface chemistry so as to permit the formation of stronger, more durable adhesive bonds to them.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Conventional coupling agent chemistry had been applied extensively to the problem of adhesive bond strength and durability with modest success. Novel approaches resulting in very substantial enhancements are required for demanding military applications of this joining technology. By analogy with carbon chemistry where highly reactive species are generated on its surface by high temperature vacuum pyrolysis and subsequent reaction with monomers and other small molecules, it is of interest to functionalize metal surfaces through the interaction of similar small molecules with appropriately activated metals. Of particular importance are the advanced structural metals such as aluminum and titanium, where a native oxide is always present on the surface.

PHASE I: During Phase I, the feasibility of functionalizing surfaces would be determined. In addition, the effect of such surfaces on bond quality would be ascertained.

PHASE II: During Phase II, promising approaches identified in Phase I would be brought to the point where they could be implemented in production environment. This would include the scale-up of necessary equipment and the generation of data as to the effect of variation of important processing parameters on the quality of resultant adhesive bonds. The specific product of this phase would be a Technical Data Package sufficient for the implementation of such a process on a production line.

A90-132 TITLE: Rugged Miniaturized Sensors for Real Time Process Control

OBJECTIVE: Development of a pressure/temperature sensor small enough to allow its insertion into the part itself or arrayed into equipment for organic matrix composite processing to enhance process control.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: During the manufacture of organic matrix composite components, the quality of the resultant parts is significantly influenced by variations in the primary processing parameter. Thus improvements in processing through the use of automation is one possible path to making composite processes more efficient, and hence cost effective. Effective automation in complicated process requires instantaneous interpretation of feedback from a multitude of sensors. However, currently available pressure and temperature sensors are often too bulky to use in certain composites processes such as pultrusion and resin transfer molding. A miniaturized sensor developed for measuring these critical process parameters could be integrated with an expert system to monitor and control a variety of composite manufacturing processes. The sensor would provide, in real time, critical temperature and pressure information, and an efficient control algorithm would anticipate and respond to future processing events. Suck a sensor should produce a signal that is interpretable and reliable at all times during the processing phase, including severe pressure/temperature environments. The thickness of such a sensor should be less than 0.1 mm to allow for easy insertion into areas that would otherwise be inaccessible. In situ sensors could be used for monitoring of wear, corrosion or other degrading mechanisms during service life.

PHASE I: Investigate and demonstrate the feasibility of developing a rugged miniaturized sensor to measure critical process parameters in real time for efficient process control during manufacturing of organic matrix composites.

PHASE II: Optimize and develop a prototype of the sensor demonstrated in Phase I along with any necessary auxiliary equipment and software. Demonstrate that this prototype has the capability to produce real time, efficient organic matrix composite process control as described in the general description above.

A90-133 TITLE: Metal Injection Molding of Tungsten Heavy Alloys

OBJECTIVE: Develop and define the processing variables required to produce net or near-net shape tungsten heavy alloy products of high structural integrity.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Currently the manufacture of tungsten heavy alloy components is labor and materials intensive. The raw, sintered material is ingot-like and requires extensive working and machining to obtain final, useful shapes. As a result tungsten heavy alloy parts can be quite expensive. Metal injection molding (a powder metallurgy process) offers the opportunity to reduce this expense by producing net or near-net shape products by eliminating the working, machining and scrap. To this point in time, there has been little or no effort to develop the processing required to produce tungsten heavy alloy components by this process. In particular, the processing variables need to be defined, i.e. percent binder, binder composition, debindering temperature and time, and sintering temperature and time. Of additional importance is the effect of metal powder particle size and distribution. Lastly, but not less important, is the shrinkage of the part from the "green" stage to the final sintered product.

PHASE I: Work in Phase I should demonstrate, on a laboratory scale, the use and limitations of currently available raw materials, e.g. binders, tungsten powders and matrix powders. Further, the work should identify the important process variables; particularly the time and temperature requirements of debindering and sintering. Also, the work undertaken should identify the maximum thickness that can be successfully sintered, and the shrinkage of the part that takes place upon debindering and sintering.

PHASE II: Phase II work will build upon the results of phase I by developing binders and metal powders that optimize the processing. The phase II work should construct an injection molding die to provide an Army relevant, tungsten heavy alloy component, and demonstrate the feasibility of producing that component by metal injection molding. The laboratory effort should continue, developing the processing necessary to scale-up the maximum size that can be successfully produced by metal injection molding.

A90-134 TITLE: SHS/Combustion Synthesis of Advanced Materials

OBJECTIVE: The objective of this program is to stimulate the United States industrial use of SHS/Combustion Synthesis/Thermite Reactions for the production of powders, coating and bulk materials.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Self-propagating High-Temperature synthesis (SHS), Combustion Synthesis of Thermite Synthesis have been demonstrated to be able to produce high performance materials – including powders, coatings and bulk materials. R&D is needed to apply this processing technology in a wider variety of applications. Traditional material processing routes involve long times and are energy intensive, whereas, use of SHS-type routes require very small amounts of energy and short periods of time.

Very large efforts in Japan and Russia have successfully demonstrated the broad application of this technology to a variety of materials: Tic abrasive pastes, bulk ceramic materials, shape memory alloys, composites, ceramic-lined metal pipes, field coating of plowshares, MoSi2 heating elements, etc. However, costs in Japan

and, especially, Russia are artificially generated so it is important to explore the true free-market costs of these introduction technologies on selected materials and applications.

PHASE I: As described above, the potential use of SHS-related technologies in the production of advanced particulate, coating and bulk materials is very large. Phase I proposals in this area should demonstrate the feasibility of concepts to produce the following: Ceramic fibers and whiskers, ceramic composite powders, functionally gradient materials, ceramic-coated pipes, bulk ceramic materials, etc.

PHASE II: After feasibility has been demonstrated in Phase I, carry out production of scaled-up version for more complete characterization and property evaluation with a goal of a prototype-type version at the conclusion of this phase.

A90-135 TITLE: Directional Solidification of Liquid Phase Sintered Tungsten Heavy Alloys

OBJECTIVE: Develop the solidification processing techniques necessary to fabricate tungsten heavy alloys with elongated tungsten grains in the direction of solidification.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: The tungsten grains in a liquid phase sintered tungsten-nickel-iron alloy grow during sintering from an initial size of 2 microns to more than 40 microns. The growth, in general, is by a mechanism of solution and reprecipitation and it may be possible to exploit this mechanism to grow elongated grains. Tungsten heavy alloys that have been hydrostatically extruded have elongated tungsten grains and these grains have been shown to increase the tensile strength of the heavy alloy with the elongated grains providing a fiber-like strengthening. The disadvantage to hydrostatic extrusion is to get reduction ratios that are advantageous it is necessary to start with large billets that require extremely high extrusion pressures. The desired goal would be to create a directionally solidified heavy alloy that had diameters that exceeded two and one half inches.

PHASE I: Demonstrate the fabrication of directionally solidified tungsten heavy alloy. Develop the processing necessary to successfully scale-up the process in phase II. Also, show how these directionally solidified alloys can strengthen the overall alloy. Also demonstrate whether or not scale-up would be possible.

PHASE II: Scale-up the dimensions of the directionally solidified tungsten heavy alloy billet to the desired dimensions. Fabricate several billets that can then be cold worked to a higher strength level and be demonstrated in Army relevant systems.

Vulnerability Assessment Laboratory

A90-136 TITLE: Air Defense and Space Systems Electronic Warfare (EW) Vulnerability

OBJECTIVE: To exploit technological advances which apply to and support the U.S. Army EW Vulnerability assessment (EWVA) program for air defense and space systems.

CATEGORY: Exploratory and Advanced Development

DESCRIPTION:

GENERAL: The U.S. Army EWVA program for air defense and space systems has been established to determine performance of systems or system concepts in hostile EW environments and to develop and recommend electronic countermeasures (ECCM) to preserve system performance in the environments. Technological advances are needed in active and passive electronic countermeasures (ECM), ECCM, ground-based, and laboratory instrumentation and techniques, and analytical methods and techniques. These areas

involve all regions of the electromagnetic (EM) spectrum. To advance ECM technology, as applied to air defense and space systems, there are requirements to address methods of active signal generation, cooperative CMs, and passive support measures (SM) such as chaff and obscurants. In the areas of ECCM, there are requirements to perform groiund-base measurements of parameters of airborne CMs such as responsive ECM, cooperative CM, and cross section or density of passive SM techniques. There are significant shortfalls in the technology supporting analysis of air defense and space systems. Work needs to be done in the development of hardware and software models of terrain clutter, chaff or obscurants, and atmospheric clutter. Another area of importance and interest is the use of fractal geometry for simulation, graphics application, and imaging decoding and reconstruction.

PHASE I: Feasibility study to determine the technical viability and merit of the concept.

PHASE II: Tangible results such as software, prototypes, etc., shall be developed to prove the feasibility of the proposed concept. In some efforts, proof-of-principle demonstrations shall be made.

A90-137 TITLE: Electronic Warfare (EW) Vuln Assessment Methodology for Communications Systems

OBJECTIVE: To develop the methodology for the computation and processing of radio performance data and network topology to assess the EW vulnerability of complex networked communications systems.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: The vulnerability analysis of a communication network involves the assessment of performance of, perhaps, hundreds of radio sets. Each radio set has a different topological aspect with respect to the remainder of the network and to the ECM threat. This project involves the development of methodology for the computation and processing of radio performance data in order to meet the requirement for assessing the vulnerability of the network and to quantify the degree of performance improvement needed to assure satisfactory network inter connectivity.

PHASE I: In Phase I the parameters used in the computation of performance will be identified and the interrelationships between parameters and measures of performance will be derived. The assessment techniques of pertinent interference waveforms will be established. The criteria for acceptable performance thresholds will be identified and the measures of performance shortfall defined. A procedure for the presentation of performance data for all radio paths in a network will be described and shown by example.

PHASE II: In Phase II the distribution of bit errors in the multiplexer signal format will be explored for various interference waveshapes. Relationships between the interference waveform parameters and the resultant disturbances on framing, signaling and voice channels will be determined. The specific waveform parameters needed to achieve particular bit error rate objectives will be optimized. A procedure for assessing the degree of jamming effectiveness enhancement achievable by tailoring the interference waveshape parameters for specific error pattern objectives will be determined.

A90-138 TITLE: Spectrally Tailored Electro-Optical Countermeasures (EOCM)

OBJECTIVE: Develop spectrally “tailored” EOCMs for active and passive CM applications.

CATEGORY: Exploratory and Advanced Development

DESCRIPTION:

GENERAL: EOCM advances are required in both decoy and jammer categories. In the decoy category, both pyrotechnic and pyrophoric materials are required that can provide spectrally tailored output to match target signatures. The burn characteristics are required to be temporally adjustable by chemical mix or physical design to allow rise time/burn time selection for maximum effectiveness against specified systems. In the jammer category, advances are required in spectrally tailored infrared and ultraviolet sources that can provide higher output radiation power levels with reduced weight, physical size, and input power requirements. Jammer modulation technique advancements is required to provide programmable waveform shapes as well as CW waveforms from unmodulated constant level output to frequencies as high as 5 kHz.

PHASE I: Theoretical studies shall be made to determine the feasibility of designing/developing advanced EO decoys and jammers.

PHASE II: Prototypes of new advanced EO decoys and jammers shall be developed. Proof-of-principle demonstrations shall be made.

A90-139 TITLE: Multispectral Scenes Simulation

OBJECTIVE: Develop a simulation that can simultaneously simulate multispectral scenes.

CATEGORY: Exploratory and Advanced Development

DESCRIPTION:

GENERAL: The technology to simultaneously simulate multispectral scenes is unavailable. A multispectral simulator is required to assess multisensor systems utilizing automatic target recognition technology. The simulator would generate scenes of backgrounds, targets, and countermeasures in multispectral domains to include millimeter wave, far-infrared, and television wavelengths. This would benefit the Army by reducing costly EW field investigations.

PHASE I: Theoretical study to determine the feasibility of designing/developing a simulator that can simultaneously simulate multispectral scenes.

PHASE II: Prototype of a simulator will be developed that can meet the objective of the effort.

Aviation Systems Command

A90-140 TITLE: Flechette Expulsion Augmentation Mechanism (FEAM)

OBJECTIVE: Design of a mechanism or insert which during expulsion increases the maximum pattern size realized with the current 2.75 inch air-to-air Flechette warhead.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: The current 2.75 inch Air-to-Air Flechette (ATAF) warhead contains either 585 120 grain or 11170 60 grain kinetic energy penetrators or flechettes. There is currently no mechanism to maximize the size of the pattern formed by the flechettes after expulsion from the front of the warhead. Increasing the flechette pattern size will result in an increase of the air-to-air effectiveness of the ATAF warhead.

PHASE I: This effort will result in the design of a Flechette Expulsion Augmentation Mechanism (FEAM) or FEAM's which maximizes the size of the 60 and 120 grain flechette patterns while minimizing the reduction in the number of flechettes in the 2.5 inch X 17.75 inch warhead cargo compartment. Additionally, this effort

shall include sufficient analysis to support all design decisions and shall address the aerodynamics of pattern formation.

PHASE II: This effort will result in the fabrication and firing test of a sufficient number of FEAM modified ATAF warheads to quantify the resulting increases in flechette pattern size.

A90-141 TITLE: Infrared (IR) Signature Reduction Flow Model Test Stand

OBJECTIVE: Develop and build a cool flow test stand for aerodynamic testing of a small scale IR suppressor component.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: The design and development of the suppressors involves mainly understanding the aerodynamic interactions of the engine exhaust gas with suppressor. Detail aerodynamic studies and development of small scale suppressors are more cost-effective on a cool flow test stand, because the cool flow test stand saves engine fuel and wear. It is also possible to make certain measurements which otherwise can not be obtained from a full scale suppressor on an engine test stand (i.e., total mass flow rate of air and flow field visualization).

PHASE I: Develop a method to accurately simulate engine exhaust gas flow in which the cool flow model test stand will provide the aerodynamic characteristics and behaviors as the exhaust gas.

PHASE II: Design and fabricate the cool flow model test stand. Demonstrate the accuracy of the model test stand in simulating engine exhaust gas aerodynamic characteristics and behavior.

A90-142 TITLE: Incident Laser Directional and Power Level Sensor System

OBJECTIVE: To develop a sensing system for Army helicopter which monitors for coherent laser energy and can determine angle of incidence and power level on the surface of the aircraft.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Emerging dynamic laser protection systems require a sensing device for triggering activation. The sensing device must be capable of determining power level of broad wavelength band consistent with eye protection. This information coupled with directional indicator would be used to activate a protective device in the affected area of a helicopter cockpit.

PHASE I: The desired result is a preliminary design for the sensor system. Work would include analytical and experimental efforts as an input to the preliminary design.

PHASE II: Development and testing of a prototype system.

A90-143 TITLE: Advanced Composite Structures Repair Technology-heat/pressure fabrication equipment/materials

OBJECTIVE: Investigate/propose innovative usage of existing/new technology, or combinations there of, in the area of heat pressure application tools/equipment/materials to improve Army aviation field level repair capability of advanced composite structures.

CATEGORY: Exploratory/Advanced Development

DESCRIPTION:

GENERAL: Currently the Aviation Applied Technology Directorate (AATD) is developing an advanced composite structure field level repair kit using existing currently available technology [tools/equipment/materials]. This existing technology is not always completely satisfactory for Army aviation field level use, considering the Army operational service environment and the following factors: cost, weight, size, versatility, power requirements, storage/shelf life, etc. Therefore, it is desired to investigate/evaluate new or improved technology.

PHASE I: Identify/discuss/evaluate the feasibility of proposed new technology and provide substantiating data, as required, to support any concept/hardware to be developed, including any prototypes.

PHASE II: Prototype hardware development/demonstration and Army field use demonstration/evaluation.

A90-144 TITLE: Particulate Sensor for Turboshaft Gas Turbine Engines

OBJECTIVE: Develop a flightworthy sensor to measure and classify sand and particulate matter entering a turboshaft gas turbine engine.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: The ingestion of sand and dust into a gas turbine engine degrades performance and shortens engine life. Current Inlet Particle Seperators (IPS) remove sand and dust from engines with very high efficiency but at the cost of power and specific fuel consumption (SFC). If a means of measuring the need for an IPS could be developed, and IPS could be designed to recover power or SFC when the environment is clean and possibly increase efficiency in severe sand environment. Also, a sensor that could measure the concentration of sand entering the IPS, could be used to estimate engine life in severe environments during a mission.

PHASE I: The objective of the Phase I SBIR effort shall be to develop a design for a sensor to determine (in real time) the concentration and nature of particulate matter as it enter the inlet of a turboshaft gas turbine engine. The contractor shall screen possible concepts for accuracy and ability of measurements and durability in severe sand environment to determine the most promising candidate. The size and power consumption of the sensor should be appropriate for application in DOD helicopters. The contractor shall evaluate the possibility of using the sensor to differentiate between water, ice, sand, and other environmental conditions. Other factors that should be considered in screening possible candidates are Electromagnetic Interference (EMI) protection (use of fiber optic output), mounting location, and system complexity.

PHASE II: The Phase II effort in this program shall include the fabrication and testing of a prototype sensor.

A90-145 TITLE: Improved Methods for High Heat Treated Vacuum Slag Remelt (VSR) and Electroslag Remelt (ESR) Steels

OBJECTIVE: The overall objective of this program is to improve the performance of highly loaded fatigue-sensitive components which use ESR and VSR steels.

CATEGORY: Advanced Development

DESCRIPTION:

GENERAL: There is a need for high-strength, high-hardness materials in Army aircraft systems. Vacuum slag remelt (VSR) and electroslag remelt (ESR) steels have demonstrated high durability and excellent ballistic tolerance. Due to their inherent brittleness, ESR/VSR steel have S-N curves that change slope abruptly at low cycles. This abrupt change in slop of the S-N curve requires better definition considering sensitivity to environmental, operational (load) and manufacturing parameters. Additional concerns include stress crack corrosion, hydrogen embrittlement and cost.

PHASE I: Improved manufacturing methods and machining techniques require investigation and their effects on performance and tool life need to be defined for various heat treatment conditions. Candidate manufacturing processes will be evaluated by fabricating coupon specimens and conducting and environmental tests. The advantage of using foam filling in hollow components will be quantified.

PHASE II: Representative components will be chosen for fabrication. Several component(s) will be fabricated from both types of steel, then tests will be performed to determine which type of steel demonstrates better performance characteristics. In-service loading and environmental conditions will be simulated for the selected components and their performance evaluated. The selected components will also be candidates for foam filling. The above noted tests will be repeated to quantify the effects of this technique.

A90-146 TITLE: High Stability Scores

OBJECTIVE: To develop a dimensionally and chemically stable core material for use in fabrication of advanced high temperature turbine components incorporating highly detailed internal cooling currents.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: This program will involve the development and evaluation of high stability core materials for use in casting small, internally cooled, single crystal turbine airfoils. Candidate materials must ultimately demonstrate the capability to form highly contoured, detailed cores. Candidate core materials must demonstrate significant improvements over current state-of-the-art. The core material developed must remain dimensionally stable throughout the casting process showing no sagging, warping, breakage, or reaction with metal. The core must be easily removed after casting. Phase I effort should involve a survey of potential high temperature core materials. Core material should be selected with the long-term high temperature exposure of casting single crystal airfoils taken into account. Core materials felt to possess the highest potential should be evaluated via trial casting. Trial cores should be complex enough to demonstrate dimensional stability. A post process evaluation should be performed to verify dimensional and chemical stability.

PHASE I: The desired results of Phase I of this effort will be selection of the best core material for production of advanced, complexly cooled, single crystal turbine airfoils. The best core material will exhibit high dimensional stability with no reaction with the base material.

PHASE II: The desired results of Phase II will be the direct demonstration of the selected core material in producing single crystal turbine airfoils which incorporate complex cooling schemes and thin walls.

A90-147 TITLE: Visualization Techniques For Displaying Cognitive Functions and Heuristic Reasoning

OBJECTIVE: Develop techniques and principles for the effective portrayal of cognitive activity and heuristic behavior as part of a user interface for computational models of human performance in a 3-D color graphic Computer Aided Engineering (CAE) environment. These techniques must be suitable for displaying a wide range of non-quantitative behavior in an intuitive manner to designers with little background in cognitive psychology or Artificial Intelligence (AI) methods.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Scientific visualization of complex analytical methods (e.g. Computational Fluid Dynamics and Finite Element Analysis) has been one of the key factors in the widespread acceptance of computer models and tools. Presenting such results in a visual manner though the use of color, patterns, and dynamic rendering has made such tools accessible by personnel with minimal understanding of the sophisticated techniques, which may underlie the presentation. However, a majority of such advances have been made in traditional engineering applications with quantitative results and processes. AI research has provided numerous modes of heuristic reasoning (e.g., scheduling, planning, search, learning, and decision making) which are useful to many man-machine integration efforts. However, the presentation of the space, the propagation of constraints, the generation and consideration on alternatives, and the application of rules of behavior are largely disclosed only through tedious tracings of the code or constructing network-like graph structures. Guidelines, sample methods, and a paradigm for presenting the process and results of such cognitive activity would greatly aid their utility and application to man-machine integration design.

PHASE I: This phase should result in the in-depth study of one or two applicable models for expository purposes, the isolation of salient attributes of the model's processes and results, and a detailed description of how such models could be effectively displayed in an interactive CAI environment.

PHASE II: This phase should produce a working demonstration of the display techniques using the model(s) selected above, along with published guidelines and techniques for display interface design which will generalize to a wide range of non-quantitative models and analysis. Some experimental testing may be appropriate to gather empirical evidence to support design choices or optimization.

A90-148 TITLE: Field Repair Techniques and Equipment for Fiber Optic Components

OBJECTIVE: This project shall develop repair requirements for optical fiber and connectors installed in Army helicopters. It shall perform an assessment of current repair techniques for adequacy in meeting these requirements. Repair methods and tools required to repair fibers and connectors in an Army helicopter shall be identified and/or developed.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Fiber optic sensors have been demonstrated to have many benefits over existing sensors. However, hesitancy exists in fielding these sensors in Army helicopters due to lack of adequate maintenance procedures and tools. This effort shall define maintenance requirements and develop repair methodology and equipment for field repair of optical fibers and connectors in an Army helicopter environment.

PHASE I: The phase I effort shall define requirements for maintenance of fiber optic connectors in an Army helicopter environment. It shall perform an assessment of current techniques and tools for adequacy in meeting those requirements. This effort shall recommend new tools and repair methodology that will improve maintainability of fiber optics within the tight confines of the Army Helicopter.

PHASE II: The phase II effort shall expand on the phase I results. Necessary tools and methodology will be developed to provide a comprehensive fiber optic connector repair system for Army helicopters. The repairs shall be capable of being performed with minimal skill requirements in the tight confines and highly explosive atmosphere of the Army helicopter and the performance of said repairs shall not degrade with the effects of the Army helicopter environment i.e., temperature extremes, humidity, vibration, etc.

A90-149 TITLE: Fiber Optic Components for Turboshaft Engine Control Systems

OBJECTIVE: To develop components of a fiber optic engine control system. The components include fiber optic sensors, fiber optic databases, optical multiplexing schemes, and electro-optic interfaces.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: Due to the ever-increasing threat of electromagnetic interference (EMI) and electromagnetic pulse (EMP), it is necessary for future turbo shaft engines to incorporate EMI immune fiber optics in the engine control system. It will be necessary for all engine sensors to be fiber optic; torque, speed, temperature, pressure, position, and fuel flow. Data will need to be multiplexed in order to take full advantage of the fiber optic's wide bandwidths. Much work needs to be done in creating small, more durable and less expensive electro-optic interfaces between the data transmission systems and the electronics in the control.

PHASE I: To uncover the most promising new technologies that will be used to replace electrical components of a gas turbine engine control system with fiber optic components.

PHASE II: To design, fabricate, and test prototype fiber optic control components.

A90-150 TITLE: Fatigue Effects of Thermoplastic Helicopter Components with Embedded Delaminations

OBJECTIVE: To determine the effects of delaminations in thermoplastic composite rotor components when subjected to fatigue loadings.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Little is know of the effects, if any, that manufacturing flaws/might have on rotor thermoplastic component strength and stiffness (as pertains to structural performance) after an extended number of flight hours. Existing quality assurance standards, which are appropriate for thermoset composite rotor components, might be too conservative for thermoplastic composite rotor components because of the thermoplastic composite materials improved facture toughness. An experimental database of fatigue effects on a thermoplastic composite rotor component's service life in the presence of manufacturing defects is required.

PHASE I: The phase I effort would entail the identification of candidate rotor components most likely to benefit by being fabricated with thermoplastic composite materials. A rotor will be selected in concert with the selections of three thermoplastic composite material systems. Coupons will be fabricated and used for testing to generate tension-tension fatigue S-N curves for the three thermoplastic composite material systems. Additional coupons will be fabricated with embedded delaminations, and these coupons will be tested to examine the effects, if any, on the generated S-N curves.

PHASE II: The phase II program will be an expansion of the phase I program in that three thermoplastic composite material systems will be used to fabricate coupon specimens with embedded delaminations of varying size and degree. A quality assurance criterion for delaminations will be established and the criteria tested through full-scale fabrication and fatigue testing of one rotor component design. A nearly void-free thermoplastic rotor component will be selected as the baseline and a sufficient number of specimens (6) will be used to establish the tension-tension S-N curve. The quality assurance criteria will then be verified through the full-scale testing of sufficient number of the selected thermoplastic with embedded declamations.

A90-151 TITLE: Nondestructive Inspection of Materials Matrix Composites for Gas Turbine Engines

OBJECTIVE: To validate and develop a novel nondestructive inspection system that can be effectively used in sub-surface inspection of metal matrix composite parts for gas turbine engines.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Titanium or titanium-aluminide based metal matrix composite (MMC) rotating components are a key technology in the development of future gas turbine engine cold sections. These gas turbine engine-rotating parts will involve bonded MMC inserts and integrally bonded MMC/homogeneous metal parts. Therefore, advanced nondestructive evaluation/inspection (NDE/NDI) techniques are needed which can effectively analyze subsequent bond line and encased MMC area. This means that NDI techniques which are applicable to surface characteristics only shall not be considered. The proposed method must be able to detect flaws and characterize bond areas, which are, will beneath the surface. Any proposed method should be a unique system or unique modification of an applicable technique, which makes the system more effective. It should also be a relatively coast effective technique.

PHASE I: Phase I work performed shall involve developments and verification of involve NDE/NDI as applied to MMC gas turbine engine parts. The proposed NDE techniques shall be verified to adequately detect flaw characteristics and material properties with repeatability on representative MMC specimens or parts.

PHASE II: Phase II work will entail further development towards a production version for systems which show promise. This development will also involve effort to allow NDE of complex shapes such as compressor rotors or impellers.

A90-152 TITLE: Semi-Automatic Scriber for Measuring Bearing Defects

OBJECTIVE: Develop a semi-automated scriber, which can measure bearing surface defects accurately and consistently. Demonstrate the performance of the system on candidate refurbishment bearing and implement the system at bearing companies and Government overhaul depots.

DESCRIPTION:

GENERAL: Current methods of inspective aircraft-quality bearing components for surface defects rely on a labor-intensive manual process using a hand-held scriber. In many cases, especially where marginal defects are involved, the ability to perform an objective evaluation is hindered by several uncontrollable human factors such as force exerted on the defect, speed of crossing the defect, distraction, and fatigue. It is desired that a computerized semi-automated scriber system be developed to replace the current hand-held scriber. The semi-automated manner over suspected defects. The data should be transmitted and processed by a computer system, which contains a preprogrammed library of defect signatures and refection criteria, form which repeatable defect assessments are made. The device should be utilized in the same manner as the current hand-held scriber. Form an operator acceptability standpoint; the device should produce a tactile feedback similar to the currently used scriber.

PHASE I: Develop a breadboard system, which demonstrates the concept. Develop preliminary computerized defect analysis database. Demonstrate performance on samples of pitted aircraft bearings.

PHASE II: Develop integrated system for potential marketing. Greatly expand computerized library of bearing surface flaws.

A90-153 TITLE: Advanced Methods for Prognosis failure of Critical Rotorcraft Components

OBJECTIVE: Develop and demonstrate new methods for prognosis of failure to support the concept of a Predictive Aircraft Maintenance System for Army Aviation.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Army Aviation currently has a requirement to develop a Predictive Aircraft Maintenance System. This concept of maintenance would utilize to the maximum extent possible prognostic rather than the existing diagnostic methods. New methods of prognosis need to be explored and tested to support this maintenance concept. This effort will develop new prognosis methods that are applicable to rotorcraft components impacting flight safety of mission essential functions.

PHASE I: Phase I of this effort would fully develop and analytically or rig test a new method of failure prognosis. Benefits, applicability and weakness of the method would be defined.

PHASE II: Phase II would implement and test the prognosis method on aircraft hardware. The result would be a verified prognosis method that could be retrofitted into existing aircraft or incorporated into future designs

A90-154 TITLE: A Technique to Assess the Cognitive Complexity of the Man-Machine Interface

OBJECTIVE: The objective is to assist designers of man-machine systems by developing a computational method of assessing the cognitive complexity associated with operating those machines. This complexity metric will be used in a Human Factors Computer Aided Engineering (CAE) workstation to give the designer feedback during the conceptual design phase on the ease of use and ease of training for various designs under consideration. Ideally, it can also be used to help locate design flaws, which are due to excessive complexity consideration.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: The driver for this requirement is aircraft crew station design using computational human factors knowledge in a CAE workstation; specific area is in the design of advanced helicopters. The current trend toward aircraft management using a glass cockpit has increased the cognitive demand on the pilot; there is toward aircraft management using a glass cockpit has increased the cognitive demand on the pilot; there is considerable concern about the pilot's ability to handle these demands during periods of high workload. A tool to assess the cognitive complexity involved in operating the aircraft having a specified cockpit design would be most helpful to the designers during the conceptual design phase in predicting the operability and trainability of the design. The approach selected should be applicable to analysis of advanced cockpits, with emphasis on Multi-Function Displays.

PHASE I: This phase should result in a detailed description for cognitive complexity and the approach chosen as well as a conceptual description of how it could be implemented on the computer.

PHASE II: This phase should result in a working version of a computerized analysis tool for assessing task cognitive complexity based on display and operational requirements associated with various cockpit designs.

A90-155 TITLE: Knowledge Base Development For Rotorcraft Situation Assessment (SA)

OBJECTIVE: Development a knowledge base for a portion of the Situation Assessment for the Day/Night Adverse Weather Pilotage System (D/NAPS).

CATEGORY: Advanced Development

DESCRIPTION: General – The major objective of the D/NAPS program is to flight-demonstrate enhanced mission effectiveness and survivability for day/night adverse weather operations through innovative integration of advanced technology to include sensor, computing which will enhance pilotage tasks (vehicle operation, communication, defensive system operation, crew/team coordination, navigation, and mission/tactical planning) during day/night adverse weather operations. The D/NAPS program as indicated below:

PHASE I: The Phase I effort shall culminate in a description of the knowledge base for a portico of the knowledge base for a portion of the D/NAPS Situation Assessment, a software development plan a D/NAPS interface description, and a test and evaluation plan.

PHASE II: The results of Phase II shall be verified software with a demonstrated capability in a software engineering environment to perform a portion of the D/NAPS Situation Assessment functions described as follows: The SA expert function shall provide a coherent and timely estimate of external objects and events based on available on-board and Command, Control, Communications, and Intelligence (C3I) sensor data. The SA function shall include the assessment of threat potential and intent, obstruction avoidance and sensor utilization planning. Sensor utilization encompasses variations in sensor performance due to light levels and adverse weather phenomena and reducing susceptibility to detection. The SA function shall asses own – ship usceptibility and vulnerability by determining threat detection and lethality zones. The rule of engagement is threat avoidance.

A90-156 TITLE: Piezoelectric Vibration Cancellation System

OBJECTIVE: Develop means of active cancellation of noise and vibration associated with rotorcraft mechanical drive trains.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Piezoelectric vibration cancellation systems have been shown to be very effective in controlling shaft lateral vibrations. Another potential application is in cancellation of noise and vibration associated with transmissions. This would require a new look at the piezoelectric actuator and high voltage amplifier to respond to higher frequencies than those encountered in shaft dynamics problems for which they were developed. Also, the vibration cancellation systems would have to contend with a broader frequency spectrum.

PHASE I: System configuration and design completion; bench validation testing of critical components.

PHASE II: System fabrication, demonstration and delivery.

A90-157 TITLE: Torque Sensor for Turboshaft Engines

OBJECTIVE: Improve accuracy and reliability of torque sensing systems on Army turbo shaft engines.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Magnetostrictive Torque Sensors are used on the T53 and T55 engines. In the past they have not been very reliable or at least not very accurate. For two engines helicopters the torque must be leveled to reduce the load on the combing transmission. The Army has need for a fundamental in torque sensors that would produce a more reliable and accurate sensors.

Several new candidate torque techniques have been developed recently. Improved magnetostrictive systems that is more linear and not so prone to drift as the presently used systems have been carried through advanced developments. Also available for application is monopole torque measuring systems and a recently conceived system.

PHASE I: Bench test validation of torque measuring principle. Finial detail design of system for engine application.

PHASE II: Fabrication, calibration and delivery of torque measuring system for turbo shaft engine.

A90-158 TITLE: Dynamic Stall Control

OBJECTIVE: Develop and demonstrate the ability to predict the quantitative features of retreating-blade stalion modern high – performance helicopter, using advanced computational fluid dynamics (CFD) techniques. Provide capability to design superior blade for increased performance, reduced vibrations, and greater maneuverability.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: Dynamic stall on the retreating blade of a helicopter rotor blade produces a loss of lift; and increased in power required; increases in pitch-link loads and vibratory stresses; and in sever cases, catastrophic stall flutter. This complex aerodynamic phenomenon severely limits the performance, maneuverability, and operational limits of helicopters, but it cannot be predicted satisfactorily be any methods available today. At best semi-empirical techniques give rough guidelines for rotors, which do not deviate significantly, form past designs. To improve the next generation of Army helicopters, improvements must be made in blade design, and this requires that the viscous flow fields on the retreating blade be analyzed and modified by exploiting the rapidly-advancing capabilities of supercomputers and advanced CFD codes. The flow is compressible, viscous, unsteady, three-dimensional, Reynolds-averaged Navier-Stokes equations with rotating, blade-fixed boundary conditions. It must capture all the essential details of the complete viscous flow field, including the trip vortex, the vortex wake, and the stalled for in the centrifugal field of the retreating blade, The numerical procedure must allow for complex tip geometries and innovative airfoil sections to be studied as a means of modifying and improving the stall behavior helicopter blades.

PHASE I: Two principal results should be achieved during the Phase I study. First, innovative new three-dimensional, viscous technology should be developed and demonstrated for the relatively simpler model problem of dynamic stall on an oscillation three-dimensional rectangular wing in subsonic flow. Second the governing equations and boundary conditions appropriate to a rotating blade should be derived, and a satisfactory explanation of how the rotating-blade formulation will be implemented in the eventual numerical code must be given.

PHASE II: The first part of the Phase I study might include preliminary validation of the numerical method by comparisons with experimental results. A more detailed validation shall be undertaken in Phase II, for which the aero flight dynamics Directorate experimental data will be made available. If appropriate, adjustments to the turbulence model may be made at this stage. The extension of the numerical methodology to a rotating blade in viscous compressible flow shall be accomplished, including the tip vortex, the vortical near wake, and the stalled flow n the centrifugal field of the retreating blade of a rotor in high-speed forward flight. In this phase, innovative methods of coupling the near-field aerodynamic calculation to the mid – and far-field wake should be investigated. Comparison with and validation by means of comparison with model or full-scale rotor experiments is highly desirable.

AIRMICS

A90-159 TITLE: Ada Programming Support Environment (APSE) Definition

OBJECTIVE: The objective of this task is to develop and implement and APSE for the command based on the command's development, enhancement, and maintenance characteristics. APSE's should be formed for these three major domains, with emphasis on large, medium and small systems.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Numerous CASE tools have been introduced into the marketplace over the last few years, completed with the fact there are multifaceted functions and level of efforts within the development, enhancement and maintenance arenas for Management Information Systems (MIS), a detailed study is needed to professionally infuse tools environments, and methodologies for each of the MIS life environments and methodologies, and produce a "how they all fit together" matrix. Therefore, in choosing an environment and a method, the appropriate tools from the matrix should dictate an appropriate APSE for an MIS/ "business data processing" domain. Phase II would be to demonstrate APSEs.

PHASE I: Phase I would be to perform the research to identify tools, environments and methodologies, and produce a "how they all fit together" matrix. Therefore, in choosing an environments and methodologies, and appropriate tools from the matrix should dictate an appropriate APSE for an MIS/ "business data processing"

PHASE II: Phase II would be to demonstrate MIS related APSEs.

A90-160 TITLE: Application of Neural networks to Executive Information or Support Systems

OBJECTIVE: Apply the techniques of neural networks to database retrieval, command interpretation (voice of keyboard), presentation of data, and/or determining relationships between variables for high level decision maker.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Neural networks are reported to be able to solve problems that defy the capabilities of traditional serial machines. This is an immature technology that does show promise in several application areas. At the same time, there is growing demand within the Army for the development and deployment of Executive Information Systems (EIS) or Executive Support Systems (ESS). EIS/ESS provide timely information that does not take long to collect or understand for high-level decision makers. EIS/ESS provide answers to the question "What is happening in my organization now?".

PHASE I: Phase would identify payoff applications of neural networks and demonstrate the usefulness on a limited problem.

PHASE II: Phase II would apply neural network techniques t the application(s) identified in Phase I to a real Army decision making environment.

Corps of Engineers

A90-161 TITLE: Self-Contained Portable/Mobile Soil Testing Field Units

OBJECTIVE: The final product will be modular soil-testing technologies, which can be packaged into portable/mobile field units for field-testing of soil properties. Army installations and other public and private organizations will benefit from rapid, in-house analysis of soil parameters needed for environmental management and engineering purposes.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: Modular technologies would be developed and packaged into application-specific, self-contained portable/mobile units which would be used to test soil samples onsite for selected soil physical/engineering properties. Soil properties if interest include: shear strength, liquid limit, plastic limit, compaction, deformability, porosity, hydraulic conductivity, water content, capillary suction, and clay mineralogy. The purpose is to enable military engineers units, Directories of Engineering and Housing, environmental protection personnel, add training land managers to obtain in-house, reasonably accurate data needed for their missions with minimum expenditure of time, money and technical personnel. The field unit could be combined with other existing technologies, which test for particle size and chemical properties (fertility, pollutants, hazardous materials). This would give installations cost-time-effective capability to detect and manage soil and water pollution problems, manage natural resources, and maximize success of engineering projects. The technology would also be applicable for other public and private agencies, such as the Park Service, Forest Service, University research, or private industry.

PHASE I:

a. Select specific soil properties to be tested by modular units, using new technology applications. Selection criteria include, but are not limited to:

    - feasibility, given current or short-term foreseeable component technology,
    - importance of soil parameter to management applications,
    - estimated cost/time effectiveness of field-testing technology as opposed to laboratory technology.

b. Select one or a few possible technology approaches for each soil parameter chosen in step (a).
c. Explore possibility of incorporating existing field soil-testing technology into suite of available modules
d. Develop the modular concept design for field units. The units could be tailored for specific applications and different operational scales ranging from backpack size to truck-mounted field laboratory.

PHASE II: The expected product development will be a flexible modular system of soil testing capabilities where units can be assembled according to buyer's desired applications and operational scale. This approach will allow for after-purchase replacement of single modules with upgraded ones as new technology becomes available, without requiring expensive replacement of an entire field unit. Development will include new technologies and/or new applications of existing technologies available on the market could be packaged with newly developed capabilities. New technology development should not include re-inventing already available field apparatus, unless such apparatus are generally considered inadequate for desired uses.

A90-162 TITLE: Laser Paint Removal

OBJECTIVE: The overall objective of this contract is to establish the ability and efficiency of paint removal from substrate with a Carbon Dioxide laser. This is a viable idea which would compete favorably with conventional paint removal techniques, such as sandblasting, with possible economic and practical superiority.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: The current status of research in this area is the successful proof of laser paint removal feasibility as a function of the beam power densities, total surface energy and paint thickness. Research has shown that steel and masonry are ideal substrate from which to remove paint by laser. The research has not identified the ideal parametric variables to give optional efficiency, thus enabling the resolution of the practicality of this machine, and constructing a field operable unit.

PHASE I: Phase I of the project should culminate in the determination of the economic and practical feasibility (as wells the safety factors) of the laser, after having found the optimal efficiency which minimizes cost and maximizes the speed and degree of the removal of paint. Consideration should be given to the user of the laser for the removal of lead based paints form steel. (Current practice of sandblast removal of these coatings creates large volumes of hazardous waste and associated disposal cost.)

PHASE II: Phase II of the project would be concerned with developing a prototype to be used in field testing, that includes a microprocessor to control the beam of the laser.

A90-163 TITLE: Ventilation Effectiveness Testing Method

OBJECTIVE: The end product will be a comprehensive testing procedure for determining the ventilation effectiveness of an HVAC system. The required instrumentation and analysis techniques must be practical for field use and suited for building commissioning.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: Indoor air quality has become an increasing concern in recent years. The American Society of Heating, Refrigeration, and Air-conditioning Engineers (ASHRAE) is revising the current ventilation standard (ASHRAE 62-1981R) in order to address the issue. The increased ventilation rates proposed in the new standard may have significant impact on the design and energy consumption of HVAC systems. A practical field method of determining ventilation effectiveness will assure a healthy environment for occupants as well as facilitate the minimal amount of energy consumption for conditioning air and providing ventilation effectiveness.

PHASE II: At the end of Phase II, a fully developed procedure including required measurement device (s) and analytical techniques will be developed. The procedure will be field tested on a variety of building types and accompanied by a complete set of documentation and instructions.

A90-164 TITLE: Design Features Based Project Data Organization Model

OBJECTIVE: To develop and test the construction project data organization concept where key project data (cost estimates, specifications, and construction activities) are linked to hierarchically organized project design features (e.g., structural frame, foundation, exterior, interior, etc.). If this concept proves to be feasible, then an integrated construction information base supporting all construction disciplines is possible.

DESCRIPTION:

GENERAL: Currently, the key project data (cost estimates, specifications, quantity take-offs, construction activities) supporting the same project are prepared and maintained disjointly and independent of each other. This makes project progress monitoring and change control an extremely difficult task.

PHASE I: In this phase, Contractor will develop a design feature based project data organization concept that unifies key project data and demonstrate the concept by actually reformatting the data from a completed project. USACERL will select and actual project and furnish appropriate data.

PHASE II: This phase depends on the outcome of the work of Phase I. The essential element of this phase is to refine and generalize the Phase I work and develop a computerized project data organization model for marketing.

CRREL

A90-165 TITLE: Ice Accretion and Persistence at Unmanned Sites

OBJECTIVE: To provide research and development resources sufficient for a small business contractor to develop to a marketable degree and instrumentation system for continuously and automatically measuring atmospheric ice accretion and persistence at unmanned sites as a function of time.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Currently available instruments do not measure ice accretion load directly, but instead measure instantaneous ice accretion rates, often on a probe that is periodically deiced. Since such instruments provide a measure of the icing rate only on surface that totally or nearly ice-free, they do not provide a measure of total natural ice load accumulated through several storms or throughout a season not do they indicate how long ice naturally resides on a surface (ice persistence).

Equipment is required that will reliably, automatically, and continuously measure and record atmospheric or sea spray ice load magnitudes with time on surface under natural of laboratory conditions. The instrumentation should be omni directional, and should measure rime, sea spray ice, or freezing rain without bias when it originates form any compass direction or slant angle form the horizon to the zenith. The probe or sensing element should be interchangeable to allow different shapes or surface materials to be tested. The instrumentation should measure accurately during extremes of temperature (+25 to –40 C) and have additional design goals for a compact, inexpensive, lightweight (backpack able) unit that has a high ice collection efficiency in a natural range of droplet sizes form a minimum of 5 microns and wind speeds to a maximum of 80 meters/second. These units should operate reliably in remote locations from a self-contained power supply for up to 8 months. Ice mass should be measured to a resolution of 0.1 g/cm2 of accretion surface. Measurements should be recorded in digital form at 15 minute intervals or less and should be unaffected by snowfall and by motion such as a ship’s movement.

This equipment is intended for long-term measurements of ice loads on small structural elements of different shapes and orientation. Electrical transmission cables, structural steel components, antenna elements, or tree branches might be mounted on the sensing unit. An additional desirable feature would be the ability to measure ice density or thickness.

PHASE I:

a. Determine the feasibility of instrumentation to meet the above standards,
b. Develop a working “breadboard model” of instrumentation which will measure ice loads on different shapes as stated above, and
c. Develop and demonstrate calibration and validation methods to verify the proper performance of the “breadboard model”

PHASE II: The contractor shall design and fabricate the equipment evaluated in Phase I. The end product to be validated and calibrated prototype instrument, which will be used in field, experiments to demonstrate the potential applications in its intended environment.

Engineering Topographic Laboratory

A90-166 TITLE: Development of Automated Methods of Change Detection for combat Support Using Digital Synthetic Aperture Radar (SAR) Imagery

OBJECTIVE: The objective is to develop an automated system that will have the capability of accurately determining short-term changes in digital SAR scenes in support of tactical operations. The features to be detected will be primarily man-made objects and the system will be developed on a Sun computer using the UNIX operating system and C programming language.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: Battlefield commanders need to know about terrain conditions on the battlefield to include locations and status of targets. They need the most up-to-date information available that can be obtained using an all weather, day/nigh imaging system such as synthetic aperture radar. To detect changes in the environment/terrain, methods need to be developed that will rapidly register digital SAR imagery and determine changes in sequences of images. Step in this process include, but are not limited to (1) acquisition, (2) image-to-map and/or image-to-image registration, (3) feature extraction of cultural/man-made features, and (4) determination of differences between previous images and most recent images.

PHASE I: Efforts will concentrate on selection of suitable SAR data sets, development of methodologies to use in solving the change detection problem, determination of available or soon-to-be developed methods of image registration and preliminary demonstration of image processing methods presently suitable for change detection. Emphasis will be on low level raster processing and then raster-to-vector methods of feature extraction. Initial testing will be done using these features: building, bridges, and vehicle (broad category-no specific identification of type of vehicle).

PHASE II: Will continue with more sophisticated methods/algorithms for feature extraction and change detection. Software developed must be delivered to the government and demonstrated on-site on equipment owned by the government.

PHASE III: Will concentrate on adjustment, testing, and verification of software developed in Phase II.

A90-167 TITLE: Detection of Long Term Changes for Updating Digital Terrain Data Bases From All Source Imagery

OBJECTIVE: The objective of this effort shall be to design, develop, test, and implement and automated system of change detection capable of detecting those military significant long-term (6 mo. To 1 yr) and /or seasonal changes. The system should provide a means of updating a digital terrain database.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: The need for timely and reliable information about military significant changes in image features plus the voluminous amount of digital imagery has created a need for automated change detection programs. Presently change detection is accomplished by time and labor intensive task, of which some of these can be performed best by a computer.

Phase I shall;

1. concentrate on the feasibility of automating photogrammetric processes such as, but not limited to, registration and rectification which may be required to effectively conduct change detection in two images of the same area but whose sensor parameters (direction, azimuth, depression single, etc.) may not be the same
2. determine how image statistics such as texture, max., min., and moments may able sued to verify changes and to screen large portions of imagery that do not contain significant changes,
3. determine the limit of how much sensor parameters nay be allowed to vary between two images before severe change detection degradation occurs,
4. Develop computer algorithms for task 1 and 2 on a 'SUN' computer utilizing the UNIX operating system, "='C' programming language, and 'X-Windows' system.

Phase II shall concentrate on the development, testing, evaluation, verification, implementation, m and demonstration of computer algorithms for the tasks in Phase I.

A90-168 TITLE: Application of Artificial Neural Networks to Object Detection from All-Source Imagery

OBJECTIVE: Identify, test and evaluate existing and/or new models of artificial neural networks (ANNs) in detecting objects in digital imagery. Develop the best model(s) into a usable system that can be trained and ideally operate in real or near Real time.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: Great amount of digital imagery from various sources must be processed in near-real time to meet national defense needs. Detecting objects is especially important to maintain updated information about important regions. Artificial Neural Networks (ANNs) show great promise in the area of recognition, which directly applies to object detection. Research to date shows that ANNs can be trained can learn form their mistakes, and once trained can operate to or near real-time. ANN technology is young and merits serious inquiry and development.

PHASE I: Will involve the following:

a. Review and evaluate existing ANN model, objectively comparing them on an object detection application.
b. Create new or hybrid models if any insight occurs as a result of the work, and compare these new model with existing ones.
c. Decide which model or models is the decisions is not clear out performs best on object detection.
d. Document experiments and conclusion in a report.

PHASE II: Will involve developing the best model or models into a usable system for object detection. A transportable software system will be fully developed, tested and implemented. The software documentation and necessary demonstrations/training for others to use the system will be expected at the end of Phase II.

A90-169 TITLE: Mission Planning Workstation

OBJECTIVE: The objective of this effort is to develop and demonstrate a terrain based mission planning/mission management workstation that will allow battlefield commanders to effectively plan, conduct and manage tactical combat operations. The workstation will provide advanced capabilities for integrating analyzing and displaying Military Geographic Information (MGI) and terrain and intelligence products.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: The tactical battlefield of the future will be highly dynamic, geographically diffuse and extremely lethal. Battlefield commanders will require detailed information about friendly and enemy force deployments, weapons emplacements and terrain and environmental conditions to plan and conduct highly mobile combat operations. Current techniques for merging and environmental conditions to plan and conduct highly mobile combat operations. Current techniques for merging and presenting this information are inadequate to support the sophisticated mission planning and mission management requirements of the tactical commander on the quick response battlefield. Recent advancements in the state-of-the-art in two-dimensional Electronic Map Display (EMD) techniques, real time three-dimensional Computer Image Generation (CIG) techniques, Artificial Intelligence (AI) decision making capabilities, Global Positioning Systems (GPS) and Geographic Information System (GIS) combined with increasingly more powerful and more compact computational, display and data storage capabilities make it feasible to develop and demonstrate advanced capabilities that currently exist in the government and industry, develop a methodology for integrating these capabilities and to assemble a laboratory test bed for demonstrating these capabilities.

PHASE I: The first phase of this project shall consist of a six month effort to (1) determine the functional requirements for a mission planning/mission management capability, (2) asses the applicable state-of-the-art within the government and industry, and (3) develop a conceptual design and implementation plan for a laboratory demonstration capability to be assembled under Phase II. The Phase I effort shall also contain an assessment of the status of other mission planning efforts within DOD (if any) and an evaluation of the potential for fielding of these capabilities to tactical users within the next 5-10 year period.

PHASE II: Under Phase II, the contractor shall develop and demonstrate in the laboratory a workstation capable of performing the functions defined n the functional requirements and conceptual design documents. As a minimum the demonstration system should incorporate capabilities for exploitation of electronic map data, digital terrain data (DTD), satellite and aerial imagery, and environmental and intelligence data. It shall contain sophisticated GIS and AI capabilities for analyzing theses data and for generating tactical decision aids and shall be capable of simultaneously generating coupled two and three-dimensional graphics in near-real-time. If feasible, it shall also contain hooks for real time positioning of tactical assets using GPS technology. The government will furnish as GFE electronic map display software, three-dimensional CIG software, GIS software and tactical decision aid software if desired by the contractor. The total efforts for Phase II shall not exceed 24 months and shall be performed over a period of three fiscal years.

WES

A90-170 TITLE: Camouflage Materials

OJBECTIVE: The objective is to develop and test low cost disposable, lightweight, camouflage netting/screening materials made of natural fibrous, possibly wood fiber, materials. The materials(s) should be weather resistant, chemical agent resistant, have high tensile strength, be suitable for long tern storage and have, or made to have with minimum cost effective treatment(s), properties suitable for visual, near infrared, thermal infrared, millimeter and microwave camouflage signature alteration.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: Current camouflage and concealment materials, largely derived form petroleum based products are relatively expensive (approximately $0.25 to #1.40 per foot square). There exists within the Department of Defense a critical need for a lower cost, non-strategic and renewable source of camouflage and concealment netting materials.

PHASE I: Identification of candidate materials. Phase I will include the survey, identification and collection of samples of candidate materials. Where possible, engineering and spectral properties will be determined from existing literature.

PHASE II: Development and testing. If suitable candidate materials were identified during Phase I, additional testing and development of techniques for improving there mechanical and multispectrual properties will be conducted. Phase II will include field-testing of prototype materials.

Army Research Institute

A90-171 TITLE: Aircrew Member Task Allocation

OBJECTIVE: Develop a method for optimally allocating task among aircrew members (pilots and copilots) so as to control workload and improve performance.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: During the system design process task that must be performed for successful system operation are allocated to either the hardware or the human operator(s). Among those tasks allocated to humans, the sub allocation to specific crewmembers is primarily based upon traditional pilot/copilot duties. This results in varying levels of workload being placed upon the crewmembers, such that at some times one crewmember relatively unloaded. The proposed study would examine the allocation of tasks to crewmembers and attempt to develop a method for optimal task allocation.

PHASE I: The initial effort would be primarily a review of previous efforts (if any) at crewmember task allocation successful Phase I might: (1) find that some method exists for crewmember task allocation; (2) it appears useable in aviation settings; (3) no specific method exists, but other techniques are available, which when modified or combined could produce the desired results; or, (4) specify the process through which a method could be developed. A highly successful Phase I might also result in the demonstration of an appropriate technique (or its approximation) in a laboratory setting.

PHASE II: This phase would produce a useable method for crewmember task allocation, validated against laboratory and/or simulator performance measures. The method would be sufficiently developed and described to permit rapid transfer to systems development agencies and contractor. One possible implementation would be as a computer model which accepts task and workload listing from existing models (such as TAWL or HOS IV) and produces proposed optimal allocations.

A90-172 TITLE: Cognitive and Temperament Predictors of Executive Ability

OBJECTIVE: To expand understanding of the contribution of cognitive and temperament predictors of executive performance, to (1) aid officer education policy formulation, and (2) create tools for developmental assessment of post company grade officers.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: The Army has a strong need for technologies to enhance the development of cognitive/conceptual skills required at senior levels of command. Convincing research evidence has now accumulated that cognitive skills are uniquely important for successful performance at higher levels. This is essentially in agreement with assertions make by Katz and Kahn some years ago. However, very little systematic understanding exists of

adult cognitive development processes, and how they can be influenced. In addition, little understanding exists of the relation between temperament dimensions, and cognitive/conceptual skill development. (That is, are there temperament individual differences that relate to cognitive/conceptual skill development, with intelligence held constant)? The overall project should accomplish the following: (1) develop a comprehensive statement of the current knowledge about adult cognitive development; (2) develop or identify temperament and conceptual skill measuring instruments developed; and (4) develop theoretically sound recommendations for methodologies to accelerate development of the cognitive skills required at high organizational levels.

PHASE I: The work to be undertaken in Phase I would consist of steps (1) and (2) above. The product would be a report laying out the work accomplished, the conclusion reached, and a plan for Phase II.

PHASE II: The work to be undertaken in Phase II would consist of steps (3) and (4) above. The product would be a series of research reports detailing the research findings, validated cognitive skill and temperament measurement tools, and theoretically sound recommendations for approaches to enhance cognitive skill development.

A90-173 TITLE: Aids for Situation Development

OBJECTIVE: Develop computer-based aids for the IEW task; situation development that can be integrated in the AI based system currently being developed by USAICS.

CATEGORY: Exploratory Development

DESCRIPTION:

PHASE I: After gaining an understanding of the procedures required to conduct the situation development task and the cognitive limitations of the analyst performing the task, develop prototype concepts of candidate decision aids. These aids should include the graphic representation of data, methods for reducing the memory requirements of the analysts techniques for overcoming the strong tendency to regard confirming information as more important than disconfirming information.

PHASE II: Learn about the objective status, plans and design features of the situation development aid now in development at USAICS. Develop the software needs to incorporate the decision aids in the USAICS system. Evaluate the aids using MI officers and modify them as indicated by the evaluation.

A90-174 TITLE: Personnel & Organizational Factors Affecting Organizational Performance

OBJECTIVE: Phase I of this research call for the development of a conceptual model that will articulate the interactions of personnel and organizational factors identified as affecting organizational performance. Phase II will seek to apply this conceptual model within the context of a “para-military” organization in order to “test” the effect of the model on organizational performance/effectiveness.

CATEGORY: Basic and Exploratory Development

DESCRIPTION:

GENERAL: The fields of organizational, industrial and personnel psychology have identified factors or variables that are though to have a direct impact on the function/performance of organizations. Such factors as, for example, individual aptitudes, individual motivation, supervisory/leadership systoles, organizational climate, personnel turnover/turbulence, have been identified as affecting the performance effectiveness of organizations. What is lacking, however, in this arena is a broad conceptual model or framework that attempts to “integrate” each of these disparate factors/variables and to apply this conceptual model or framework within the context of a demonstration project.

PHASE I: The requirement for Phase I of this SBIR program calls for the development and articulation of a conceptual model/framework that takes into account the direct and interactive effects of the identified "predictor" factors.

PHASE II: The requirement for Phase II of this SBIR program calls for the execution of a demonstration project that will apply the model developed in Phase I within and organization. Given the inherent difficulties associated with conducting such a "demonstration project" within a military unit (i.e. and Army Battalion) it is proposed that the demonstration project seek to execute the model within a "para-military" organization such as a local police of firefighting element. It is felt that the ability to "transfer the lessons learned" from such a "para-military" organization to the military will provide a "best" test of the model.

A90-175 TITLE: Morale, Social Climate, and Job Satisfaction Indicators for the U.S. Army

OBJECTIVE: The objective of this research is provide a model of the climate of the Army. Normative, base-rate information is needed for tracking the climate of service members and family members over time and for sub-group comparisons for a variety of research efforts.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: There are a number of importance constructs central to organizational research on the Army for which forms have not been developed. Research on the Army advanced by the development of unique scales for each effort or by ad hoc adaption of scales developed for civilians. Because there is often insufficient time in each research effort to develop psychometrically sound scales with normative information, and to avoid duplication of effort in separate research efforts that need to use a scale for the same construct, a handbook of measures and scales is needed by Army researchers.

PHASE I: The objective of Phase I is the identification of constructs for which scales and norms have been developed as well as constructs for which measures are needed. Take together, these measures and scales should provide a model of the climate of the Army that covers such areas as job satisfaction, career maturity etc. Needs for, and the availability of, normed measures should be based on a review of the available civilian and military literature as well as from information gathered by interviews and/or surveys form personnel in Army and other military organizations that should have knowledge of such. The product of Phase I will be a report on (1) the psychometric properties and available (civilian, military, and Army) norms for scale which have been development of needed scales complete with psychometric assessments and normative information. Plans for gathering normative information should focus on Army norms.

PHASE II: Will consist of the execution of the research plan developed in Phase I, or that portion of the plan that can be executed within available resources. Phase II products include:

A handbook of the scales identified in Phase I and those that are developed, scaled, and normed in Phase II.
A finial technical report on the development, scaling, and norming of the measures as well as recommendation for future efforts.

A90-176 TITLE: Measurement of the Performance of Army Tactical Units

OBJECTIVE: To establish methodology for improved measurement of performance of Army tactical units.

CATEGORY: Basic Research and Exploratory Development

DESCRIPTION:

GENERAL: The Army needs to be able to adequately measure the performance of its tactical units in order to estimate the Army's combat capability, diagnose training requirements, and determine the resources required to support training. Measurement is also essential for evaluating new weapons systems, tactics, and organizational designs. Measurement needs to address all levels from squad through battalion task force.

The Army traditionally has used mission/task analysis to establish the attributes of performance, which should be trained and evaluated. While useful, by its very nature the analytic approach leads to emphasis of "fractional" parts of performance and often fails to capture the dynamic, emergent, interactive and tightly coupled aspects of unit performance. Additional approaches are needed which emphasize synthesis and more integrated, molar performance indices. The natural of such molar indices any be suggested by the high level constructs contained in, for example, "combat fundamental", "tenets of the air land battle", etc., described in military history and doctrine. Alternatively or complementarily, it may be useful to apply mathematical and modeling techniques to the problem of identifying and measuring molar aspects of unit performance.

PHASE I: The objective of this phase are to: (1) formulate hypothesis, theories, or models which identify molar aspects or attributes of unit "performance" which should be observed and measurement operations and analytic techniques which permit their testing and validation: (3) conduct analyses to demonstrate the feasibility and potential utility of the methodology. Data from the National Training Center (NTC) and Joint Readiness Training Center (JRTC) can be made available for these analyses. The final report will fully describe the process and result of this phase.

PHASE II: The objective of this phase is to validate and refine the methodology and measures. This will involve extensive application of the methodology to real data and comparison of the results with results form other methods of describing and assessing unit performance, The final report will fully describe the process and results form both phases.

Medical Research and Development Command

A90-177 TITLE: Medical Countermeasure Against Low Molecular Weight Toxins

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: Low molecular wrights toxins, such as sax toxin and blue-green algal toxins, have been suggested as potential threat agents. The molecular site of action of many of these toxins has been identified, e.g., binding to and blocking the sodium channel, however appropriate therapy and prophylaxis still needs to be addressed. Research proposals designed to investigate potential medical countermeasures such as vaccines, antibodies or drug prophylaxis and treatment regimes are strongly encouraged.

A90-178 TITLE: Monoclonal Antibodies Against Low Molecular Weight Toxins

OBJECTIVE: Develop human monoclonal antibodies against low molecular weight toxins and nerve agents

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: Using novel techniques of in vitro stimulation of human spleen or peripheral cells or recombinant conversions of mouse monoclonals, produce human monoclonal antibodies with specificity for importance toxins and threat agents. Analogs are available.

PHASE I: Preliminary data that the system proposed works to produce human monoclonals with desired specificity.

PHASE II: Full development of human monoclonals against a specific agent.

A90-179 TITLE: Medicinal Chemistry – Synthesis of Potential Drugs Effective Against Toxic Agents of Biological Origin

OBJECTIVE: The objective is the design and synthesis of chemical compounds, which potentially will prevent or counteract the toxic effects of agents of biological origin.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: Toxic agents of biological origin such as botulism, anthrax, bertadoxin, breve-toxin, anatoxin A, Ricin, etc. are potential threat agents. There is an interest in chemical compounds, which potentially will prevent (pretreatment) and/or counteract (antidote-treatment) the toxic effects of such or any individual, agents(s). Topical or systemic applications will be considered. The drugs need to be reasonably non-toxic and fast acting. The compounds proposed should be based on a biological rationale and the compounds prepared are to the submitted in 3-5 gram quantities to the U.S. Army Medical Research and Development and Command (USAMRDC) for biological evaluations. The submitted compounds are to be fully characterized and be of high purity (>99.5%).

PHASE I: Submission of potential drugs in the appropriate quantity and quality to USAMRDC for screening against the targeted treat area.

PHASE II: Submission of additional quantities and analogs of active molecules will accomplish this phase.

A90-180 TITLE: Detection, Diagnosis and Therapy for Toxin Exposure

OBJECTIVE: Develop systems to detect/diagnose toxins in biological samples. Develop pharmacologic therapies efficacious in man.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: Development of means of detection or diagnosis of exposure to toxins of interest that are sensitive, specific, reliable, and rapid for field uses are needed. This system should be applicable to biologic such as blood, urine or other clinically attainable samples.

Development of pharmacologic therapy efficacious prophylactic ally and post-exposure and safe in mans is also needed. Therapy that is effective for multiple effective or multiple intoxications is desirable.

Toxins of principal interest include, ricin, microystin, pal toxin, sax toxin and lyngbyatoxin as well as other low molecular weight peptide, and proteins toxins. Channel active toxins, pre and postsynaptic toxins, and protein synthesis inhibitors are of interest.

PHASE I: Show proof of principle of systems to detect/diagnose toxins in biological samples. Show proof of principle of an efficacious pharmacological therapy.

PHASE II: Prove either system using multiple toxins

A90-181 TITLE: Diagnosis of Natural and Induced Diseases of Military Importance

OBJECTIVE: Develop, standardize and produce systems for rapid identification and diagnosis.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: This effort is designed to provide state-of-the-art technology to develop a system for rapid identification and diagnosis of agents or diseases acquired naturally or by exposure to biological weapons. The system will provide for rapid identification of agents/diseases through examination of clinical specimens such blood, urine, spinal fluid and throat washing. The system should be extremely sensitive, specific and reliable. There is interest in production of both monoclonal antibodies, and development and production of synthetic polypeptides for use as antigens. Method utilizing labeled molecular probes for the identification and analysis of microbes or their products are also of interest.

PHASE I: Develop proof of principal of a new state-of-the-art system for identification/diagnosis of agents/diseases.

PHASE II: Prove the system using multiple agents and clinical samples.

A90-182 TITLE: Medicinal Chemistry – Synthesis of Potential Antimaloria Drugs

OBJECTIVE: The objective is the design and synthesis of chemical compounds potentially orally effective against malaria.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: Malaria continues to be a major health problem in many parts of the World. The utility of current drugs for the treatment of malaria is becoming less effective due to the development of orally drug effective against resistant Plasmodium falciparum malaria. The compounds proposed should be based on biological rationale and the compounds prepared are to be submitted in 3-5 gram quantities to the U.S. Army Medical Research and Development Command (USMRDC) for biological evaluation. The submitted compounds are to be fully characterized and be of high purity. (>99.5%)

PHASE I: Submission of potential drug in the appropriate quantity and quality to USAMRDC for screening against the targeted threat area.

PHASE II: Submission of additional quantities and analogs of active molecules will be accomplished during this phase.

A90-183 TITLE: Detection of antibody to antigen of and/or nucleic acid of the virus of enterically transmitted non-A non-B hepatitis (Hepatitis E virus)

OBJECTIVE: Develop tests by which antibody to, antigen of and nucleic acid of the virus of enterically transmitted non-A, non-B hepatitis (Hepatitis E virus) may be detected in clinical and laboratory specimens.

CATEGORY: Exploratory Development

DESCRIPTION:

GENERAL: HIV has been demonstrated to be the cause of enterically transmitted non-A, non-B hepatitis in outbreaks in India, Pakistan, Nepal, Mexico and the Sudan. Both virus and antibody can be detected at present using immune electron microscopy, a cumbersome and time-consuming test. An immunofluorescence assay, using infected liver as the antigen, has been developed but is not widely available. A test based on combinations is needed to advance our efforts to manipulate this virus and perform serosurveys.

PHASE I: All work will be done I support of and in close coordination with in-house investigators working on the same goal. A detailed research plan will be developed. Using the vary small quantities of antigen, antibody and infected lever available, demonstrate clear evidence of sensitive and specific detection of both. Demonstrate that the test yield appropriate results on coded specimens. Provide all necessary information and training so that Walter Reed Institute of Research (WRAIR) personnel can become expert in performance of the tests.

PHASE II: The test will be produces in quantities suitable for use in screening large numbers of serum and/or stool specimens. Large numbers of specimens will be tested. All aspects of the technology, including reagents, standards, controls, instructions, will be transferred to WRAIR for further evaluation development and application.

A90-184 TITLE: Expression of flavivirus genes and production of proteins suitable for testing as vaccine candidates

OBJECTIVE: Express flavivirus genes and purify protein products which are immunogenic and which protect against disease caused by flavivirus in available animal model systems.

CATEGORY: Advanced Development

DESCRIPTION:

GENERAL: Expression of flavivirus I and NS1 glycoproteins as recombinant proteins has been achieved in several systems including E. coli, baculovirus and vaccine. These have been evaluated for protection in the mouse model. Generally, none of the recombinants protected as well as inactivated virus. Development of a system or systems for expression of high levels (> 10 mg/liter of cells) of immunogenic, fully protective proteins is required. Possible systems include those mentioned above and any others such as yeast or mammalian cells. Any expression system used should be suitable for eventual human sue into hat the product(s) should be amenable to purification.

PHASE I: All work will be done in support of and enclose coordination with in-house investigators. A detailed plan will be developed. Walter Reed Army Institute of Research WRAIR will provide all genes, sequence information and antibodies for detections of recombinant proteins. Incumbent will engineer genes into a form suitable for expression, clone genes into high-level expression vector(s) and express the genes. Incumbent will verify authenticity of expressed proteins and their antigenicity and will provide WRAIR with know quantities of protein for immonogenicity and protection testing (at least 1 to 10 mg will be required). Proteins, which in unpurified form are as immunogenic and protective as inactivated or live, attenuated viruses are desired.

PHASE II: Based upon results of protections tests, production of proteins will be scales up for purification and protection testing of purified materials. If optimal levels (i.e. >10mg/liter) of expression are achieved and the product is fully protective, purification of the product to a degree suitable for human use will be undertaken by the incumbent. Testing of the purified product(s) will be done be WRAIR.

A90-185 TITLE: Medicinal Chemistry – Synthesis of Potential Anti Vesicant and Anti Vesicant Drugs

OBJECTIVE: The objective is the design and synthesis of chemical compound, which have potential use as drugs against the effects of vesication agents and/or cyanide poising.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: Vesicants, especially sulfur mustard, and cyanide have recently been used on the battlefield in various parts of the World. The current course of treatment for the effect of sulfur mustard and other vesicants, and the toxic effect of cyanide poisoning are not ideal. Better drugs are needed to offset the effects of these toxic agents. Both treatment and pretreatment approaches are desired. Topical or systemic applications will be based on a biological rational and, the compounds prepared are to be submitted in 3-5 g. quantities to the U.S. Army Medical Research and Development Command (USEMRDC) for biological evaluation. The submitted compounds are to be fully characterized and be of high purity (>99.5%).

PHASE I: Submission of potential drugs in the appropriate quantity and quality to USAMDRC for screening against the targeted threat area.

PHASE II: Submission of additional quantities and analogs of active molecules will be accomplished during this phase.

A90-186 TITLE: Ion Exchange Unit

OBJECTIVE: Produce a small water purifier based on ion exchange.

CATEGORY: Engineering Development

DESCRIPTION:

GENERAL: There is need for a device, based on ion exchange, to high purity water in the field from a potable water source. This device must be no larger than a 12 oz. Beverage can, must have an exchange capacity of at least 1 g. as sodium chloride, must produce water with a specific resistance of at least 1 megohm, and must be operable in any position (i.e., horizontal or vertical) without loss of exchange capacity (i. e., without excess channeling).

PHASE I: Phase I will require demonstration of the principle by which such a device could be made.

PHASE II: Phase II will require meeting the numerical limitations.

A90-187 TITLE: Instrument to Measure the Oxygen Equilibrium Curve

OBJECTIVE: Develop an instrument to measure, record, and analyze the oxygen equilibrium curve of blood and/or hemoglobin solutions

CATEGORY: Engineering Development

DESCRIPTION:

GENERAL: No standard method is available as a commercial instrument to measure, record, and analyze the oxygen equilibrium curve of blood and/or hemoglobin solutions. Such methods have been developed in this laboratory, but only “breadboard” instruments are available. The objective of this project would be to implement existing methods in a single instrument package consisting of a thernostatted reaction cuvette, computer-controlled oxygenation and data recording and display, and evaluation of data by computer programs provided by this laboratory. This instrument would be used by laboratories evaluation the properties of hemoglobin-based red cell substitutes.

PHASE I: Construct a working version of the instrument existing in our laboratory.

PHASE II: Construct a precommercial version that could be mass-produced by a commercial vendor.

A90-188 TITLE: Biologically Compatible Adhesive

OBJECTIVE: Develop a biologically compatible adhesive that will successfully maintain the adherence of a dermal dressing to moist (perspiring) skin on active soldier working in hot humid environments without producing adverse reactions (rash, itching).

CATEGROY: Advanced Development

DESCRIPTION:

GENERAL: The adhesive should be compatible with and applied to a semi-occlusive material so that it will function successfully in keeping a dermal dressing adherent to the skin for at least three days on active perspiring soldiers. The semi-occlusive material to be used is designed to protect the underlying would from exogenous contamination (dirt, bacteria, water) yet allow adequate air and water vapor exchange to keep the ground moist without pooled fluid accumulation and allow the skin to "breath" so that a rash doesn't develop. The adhesive should not interfere with these properties. The adhesive must be strong, water resistant, hypoallergenic, and nonirritating to skin.

PHASE I: Demonstrate the feasibility of producing a adhesive which will adhere to skin under severe humidity conditions.

PHASE II: Develop adhesive, which adheres to skin under severe humidity conditions and is biocompatible and will not produce adverse skin reactions.

A90-189 TITLE: Microencapsulation/Passive Dosimeter Development

OBJECTIVE: The objective is to develop a passive dosimeter badge for HC1 using the technique of microencapsulation.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: Operators of military weapons systems which use perchlorate based propellant can be exposed to short term high concentrations of HC1. In order to assess the adverse health effects and predict the performance decrements associated with exposure to HC1, accurate methods need to be developed to measure the peak concentrations. Passive dosimetry is particularly attractive because of portability, ease of operation and cost considerations.

PHASE I: Various combinations of pH sensitive dyes and buffers will be microencapsulated and incorporated into a badge. These badges will be tested for response to peak concentrations oh HC1 as well as real time response. When favorable laboratory results have been obtained, the next phase of the project will be initiated.

PHASE II: The HC1 dosimeter badges will be tested under field conditions in conjunction with several other techniques for monitoring HC1. If there is a good agreement between the results of the HC1 dosimeter badges and those approved methods, the badges will be produced in large quantities for routine monitoring of HC1 exposure.

A90-190 TITLE: Development of a Bench-top Industrial Hyglene Test Chamber

OBJECTIVE: To design and build an air-tight bench-top test chamber for generating a known built-up concentration and air dilution under controlled conditions for testing of aerosols, particulate, gases and vapors.

CATEGORY: Exploratory, Advanced and Engineering Development

DESCRIPTION:

GENERAL: Many test chambers of various sizes, shapes, complexities, and designs have been custom-made for academic use in industrial hygiene training. Most of them require elaborate set up and complicated computations prior to use. A small, simple test chamber with features for dynamic dilution, controlled contaminant generation mechanism, and controlled air dilution has always been a desired industrial hygiene item. In this laboratory, such chamber can simplify efforts involved in developing field sampling techniques. The chamber can be used for generating and containing particulate and aerosols for particle size determination. Exposure situations relating to ventilation inside armored vehicles can be simulated. Efficiency or respiratory protection against certain substance of interest can be verified. In field application, the chamber can also be used as dynamic dilution chamber, offering efficient calibration of direct reading air monitoring instruments.

PHASE I: The calculation of the dynamic concentrations in a chamber of given dimension needs to be simplified and designed into the test chamber. Given a desired dilution dynamic concentration, one can follow a simple sit of instructions to determine the amount of test substances needed, the rate of generation, and the rate of air flow. The substance generation and the air flow rates can be selected by adjusting the control mechanisms equipped with the chamber. The chamber needs to be constructed of steel frame for sturdiness, of rubber seals to ensure air tightness, and of plexiglass for viewing, and with access door for testing equipment and for cleaning.

PHASE II: The test chamber needs to be field tested for a variety of industrial hygiene equipment, and the accuracy and reliability must be prove and documented.

A90-191 TITLE: Development of a Rapid Field Water Microbiological Detection Capability

OBJECTIVE: Develop real time or very rapid field method to detect and quantify microbiological pathogens (virus protozoa and bacteria). Detection must be sensitive to pathogens levels which, if consumed in field water, would cause illness.

CATEGORY: Basic Research and Exploratory Development

DESCRIPTION:

GENERAL: Current preventative medicine methods for determination of field microbiological water quality are limited to detection and quantification of total coliform bacteria which has significant limitations in the detection or waterborne viruses and protozoa. The current methods require a minimum of 18 hours sample incubation before results are known. A new improved testing capability had been identified in an o&o plan titled “Family of Medical Water Quality Monitoring Equipment.” This project will develop new indicators by field Army preventative medicine personnel.

PHASE I: New technologies or methods must be demonstrated to be capable of detecting and quantifying common, representative waterborne, bacteria, viruses and protozoa. Feasibility studies should show that the methods can provide answers within 60 min of the test. Methods must not require sophisticated or major analytical equipment that can only be used in a dedicated laboratory facility.

PHASE II: Expand studies to detection of all major groups of pathogenic waterborne microorganisms. Develop instrumentation or methods for use in a field environment which minimizes weight, cube, power requirements, meets RAM requirements, and is easy to learn by 91S MOS personnel.

A90-192 TITLE: Ocular Protection from Laser Hazards

OBJECTIVE: Devise fabrication and testing

CATEGORY: Advanced Development

DESCRIPTION:

GENERAL: A requirement exists to provide ocular protection to troops at risk from laser energy exposure and ballistic fragments. The US Army is interested in research and development to improve concepts, devices and mechanisms that offer substantial ocular protection from multiple laser wavelengths without degrading essential visual performance. Techniques developed should be adaptable to standard spectacle, goggle, and visor configurations. End items should be resistant to abrasion and impact from ballistic fragments.
Particular emphasis should be given to the synthesis or development of absorbing dyes or chromophores that can be incorporated into or onto polycarbonate eyewear that reject wavelengths greater than 700nm.

PHASE I: Identify a viable concept or device with sufficient laboratory data to demonstrate feasibility.

PHASE II: Further develop the concept of devices and deliver a device for government testing.

Army Strategic Defense Command

A90-193 TITLE: Electronic Materials

OBJECTIVE: The objective of this topic is to provide the necessary advances in electronic materials in order to improve the technology base designing and developing lightweight, radiation hard, high performance electronic circuits for use in interceptors, active and passive sensors, and data/signal processing devices used in anti-satellite applications.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: Novel ideas which improve radiation hardness, performance, power requirements, capability and/or weight of integrated circuits, detectors, sensors and other electronic or electro-optical components are sought in areas such as: Quantum- well /superlattice structures which support “band gap engineering”, new organic and polymer materials with unique electronic/electro-optical properties, microstructure waveguides, solid state lasers, optical detectors, exploitation of single crystal diamond electronic properties, and high frequency transistors.

PHASE I: This phase should demonstrate the feasibility and scientific or technical merit of the proposed idea in order to reduce the risk involved in the Phase II effort. The demonstration should consist of an experiment or simulation that clearly shows the potential of the concept, ie..the fabrication and characterization of a light emitting diode using new materials, novel processing, or new concepts.

PHASE II: This phase should address critical issues and result in a well defined product or process ready the commercial development of a specific application. For example: activities would consist of determining performance as a function of process variables and addressing the critical issues, which could include the intergration of, perhaps a transistor with the other elements of a logic circuit for a given application.

PHASE III: This phase should consist of applying the technology developed in the previous phase application, such as, fabricating components which would be incorporated in a neural network system for data/signal processing in an ASAT interceptor or other commercial applications.

A90-194 TITLE: Neural Network Software/Hardware for directed and Kinetic Energy Antisatellite (ASTA) Weapons System

OBJECTIVE: to develop new and innovative neural network algorithms and architectures that will aid in developing a real- time, economical and reliable kinetic and directedenergy antisatellite (ASAT) weapons system.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: Directed Energy (DE) and Kinetic Energy (KE) antisatellite weapons system is a vital candidate system to our nation's defense. This weapons system has a need for knowledge base systems that are economical to provide accurate information in real-time. A neural network is a computational structure modeled on biological processes. Some of the key features of the neural network are it's trainability and speed. Neural networks are a powerful tool that can increase the power of DE and KE antisatillite weapons knowledge base systems by helping the system learn faster and with less human programming. Approaches are sought to extend or improve present ASAT concepts, facilitate and reduce the cost of the concepts. Elements of the systems include but are not limited to weapons pointing, beam control, acquisition, tracking, sensor focal planes, signal and data processing, guidance and control algorithms, control of cyro- coolers, array image processing, and other ASAT systems components.

PHASE I: the first phase will conclude the feasibility of the concept thru simulation and/or prototype and the applicability of the concept ASAT weapons system. It will also show the merit of furthering the concept to a phase II.

PHASE II: The second phase will incorporate the principle developed in phase I into a prototype or show proof of principle and feasibility for incorporation into the ASAT demonstration phase commercial applications will be considered.

PHASE III: Results of Phase I and II shall lead to a phase II that will incorporate the developed principles into a specific ASAT test application and/or lead to specific commercial application.

A90-195 TITLE: Sensor Signal and Data Processing

OBJECTIVE: New and innovative approaches offering order-of magnitude improvements to sensor signal and data processing performance, power, weight, size and cost are desired.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: Modern sensors produce vast amounts of electronic signal information which must be processed quickly and accurately to perform surveillance and target tracking functions. Signal processing of the sensor data is first performed to identify object detections. Data processing is then performed to handle target tracking and other high level functions. Advances are needed both in hardware architecture and in algorithms to handle nuclear effects mitigation, structured background removal, object dependent processing, and multiple target tracking.

PHASE I: A Phase I effort will identify one or more specific functional elements of the signal and data processing chain and seek a sizable and realizable improvement to the components. This will include design and simulation of the improvement and proof of its technical merits.

PHASE II: Phase II will develop the signal or data processing improvements from Phase I for a more detailed simulation/prototype demonstration of the advantages of the resulting hardware or algorithm.

PHASE III: This Phase will involve the application of the processing innovation to real systems with possible industry or government cooperation. The product that emerges from the Phase I and II research shall such that in Phase II either more research is required to finalize the development or it is to be introduced into the ASAT demonstration program and/or introduced into the private sector commercial market.

A90-196 TITLE: Optical Computing and Optical Signal Processing Technology

OBJECTIVE: Develop innovative optical materials, devices components, architectures, and algorithms that will advance the technology. The innovative concept shall lead to a product that will increase performance for a specific function and/or reduce the power, weight, size, ect., of a component required by the ASAT system. This can be in any aspect of BM/C3, surveillance, acquisition, track or kill assessment, ect.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: Orders of magnitude advancement in performance is needed in hybrid opto-electronic and in optical computing and signal processing systems. This requires new and significantly enhanced nonlinear materials and photonic devices; acousto and electro-optic components; optically and electronically addressed SLMs and array processors; holographic techniques; reconfigurable interconnects; massive fan-in/fan-out and tectures. Applications include neural-network processors as well as general-purpose analog and digital computers and special-purpose coprocessors.

PHASE I: the results of this effort will provide proof-of-concept feasibility by means of preliminary design, simulation, and laboratory experimentation. The product should be directly linked to some subsystem of the ASAT program and have potential commercial application.

PHASE II: the results of this effort will include the detailed design, fabrication, demonstration, and testing and evaluation of a working, but not necessarily optimized, bread-board model. Consideration must be given to, and direct application shown, for improvement to some element of the ASAT program. Phase II must provide insight into the Phase II program which can be further government funded development (a procurement) or private sector commercialization.

PHASE III: this effort will be the commercialization, as well as military application in missile interceptors and satellites, of high-density high performance optical signal and data processing systems or subsystems.

A90-197 TITLE: Robotics and Artificial Intelligence

OBJECTIVE: The objective of this research is to explore innovation, novel decision aid concepts and robotic technology for ASAT application including BM/C3 functions.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: Innovative ideas for research designed to enhance an ASAT system decision making capability under severe environments are sought. Also, innovative concepts for robotic techniques which will either aid in the maintenance of a deployed ASAT system or in the manufacture of components for an ASAT program are requested. Genetic algorithms and other self adapting concepts which both reduce the time required to reach a decision and improve the decisions made are of particular interest.

PHASE I: During this phase, an innovative concept will be investigated and feasibility established via mathematics, computer simulation, prototyping or a combination of these. The concept must be shown to lead to a product that con go into a Phase II and have potential for a Phase III.

PHASE II: A robotic technique or AI concept must be developed towards a clearly identified ASAT requirement. It must further be shown to have the potential for commercialization for either or both the government, not the private sector. A robotic manufacturing demonstration, or a demonstrated expert decision system for the BM/C3 function are examples of a Phase II program.

PHASE III: The results of Phase I and Phase II will be integrated within an ASAT system that will be used in an actual ASAT demonstration and validation experiment/or lead to a specific commercial application.

A90-198 TITLE: Computer Architecture, Algorithms, and Languages

OBJECTIVE: Demonstrate novel or innovated approaches for ground and space computer architecture, algorithms, and language to support target acquisition, tracking, classification/discrimination, kill assessment, and battle management/command, control, and communications (BM/C3).

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: The U.S. Army is pursuing the development of a kinetic energy antisatellite (ASAT) vehicle. The ASAT program includes both ground support and interceptor vehicle. This surface based ASAT program demonstrates current technology and will initiate product improvements as new technology becomes available. In support of this program, the following areas of interest are identified.

Computer architecture shall improve processing speed, be parallel or distributed in layout, be more secure, with increased fault-tolerant capabilities, and have higher reliability. Algorithms shall increase data processing with numerical techniques. Languages shall optimize operating systems for computer architectures, demonstrate improved man-machine interfaces, and allow for easy software updates and system testing.

PHASE I: To investigate and analyze the various approaches toward solving a particular problem area and recommend a single defined method. The method should be based on innovative concepts that will provide benefits to the ASAT program.

PHASE II: to determine the Phase I method though a design, fabrication and/or encoding, and testing. During demonstration, the procedures to implement the method, schedules, resource requirements, and testing are documented and evaluated. Periodic testing provides a means of assuring that method can be successfully implemented.

PHASE III: This Phase shall lead to components or systems that can be integrated into the ASAT prototype or demonstration program. Also, this phase should provide new products for civilian markets based on technology transfer.

A90-199 TITLE: Laser Communications

OBJECTIVE: Research technologies which will enhance the feasibility of a laser communications network for elements of the ASAT program.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: A critical element of the ASAT program is a communications network. Highly desirable characteristics of a communications network are: high data rate, high resistance to jamming, rapid acquisition and tracking, switchable links, wide field of view, and secure links. This program is structured to explore the relevant technology areas which support laser communications links. These support technology areas include, but are not limited to: laser, laser beam steering/control; modulation techniques/systems; receiver techniques/systems; and networking concepts.

PHASE I: New and innovated concepts are sought which will enhance the feasibility of laser communications links/networks. The Phase I efforts should be structured to determine the feasibility of the proposed concept by the end of the Phase I performance period.

PHASE II: After the feasibility of the proposed concepts has been established in Phase I, the evolution of this concept will be continued during the Phase II effort. The concepts will be implemented in software/hardware to demonstrate the engineering feasibility of the concept and any critical engineering bottlenecks will be addressed and solved.

PHASE III: Following a successful Phase II effort, proposed concepts should have evolved to the point that full scale engineering development can begin to incorporate the concepts into a firm design as a component or major subsystem of a laser communications link/network.

A90-200 TITLE: Propulsion and Propellants for ASAT

OBJECTIVE: Develop innovative propulsion materials, devices, and components to provide substantial performance improvement and weight/volume reductions for kinetic energy weapons that use solid propellant rockets or hybrid liquid-solid energies.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: Orders of magnitude advancement in performance is needed in advanced rocket propellant materials, motor cases and nozzles and processing technology. This requires new and significantly enhanced energetic polymers, novel oxidizers; high strength to weight materials for rocket motors and nozzles; miniaturized devices and components, and improvement in automation science for chemical process that contribute to safe mixing and flow of inprocess, highly toxic and energetic propellant ingredients.

PHASE I: The results of this effort will provide proof of concept feasibility by means of a preliminary design, simulation, and laboratory experimentation.

PHASE II: The results of this effort will include the detailed design, fabrication, demonstration, and testing and evaluation of a working preliminary breadboard model.

PHASE III: The hardware should be developed to the stage where it can be demonstrated in a flight test.

A90-201 TITLE: Nuclear and Non-nuclear Power and Power Conditioning

OBJECTIVE: The goal of the program is to provide advanced, light-mass, compact nuclear and non-nuclear power sources for ground and space based components of the ASAT system.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: Both steady-state and burst models of power, ranging for kilowatts to megawatts, will be required. This will include high-efficiency energy conversions cycles, high performance thermal management concepts and other power related technologies. High energy density systems are required for sustained power but innovative concepts that deliver extremely high power pulses in short periods of time for the weapons systems will also be considered.

PHASE I: The results of this effort will provide proof of concept by means of preliminary design, simulation, and/or laboratory, experimentation.

PHASE II: the results of this effort will include detailed design, fabrication, evaluation of a working but not necessary optimized, breadboard or brassboard model.

PHASE III: the results of this effort will include hardware or components developed to a state where they can be demonstrated in a flight experiment.

A90-202 TITLE: Sensors, Detection, Tracking and Kill Assessment

OBJECTIVES: The objective of this program is to develop innovative sensors and related technologies ASAT program.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: the objective of this program is to develop innovative sensors and related technologies for the ASAT program. Sensors and their associated systems swill function as the “eyes and ears” of an ASAT system providing target detection, target tracking and kill assessment. New and innovate approaches to these requirements using advanced concepts are encouraged across the electromagnetic spectrum, from radar to gamma-rays. Passive, active, and interactive techniques for acquiring and tracking targets against a variety of backgrounds are solicited. In addition to novel sensing concepts, sensor-related devices technology is also needed, with the intended goal of producing either a specific product or process. Examples of some of the areas addressed are: advanced focal plane arrays, range-doppler ladar and radar, imaging (different wavelengths) improvement of detector efficiency, sensor fusion, gamma, x-ray and neutron detection, detection, agile lasers, radiation sources, and countermeasures to sensor of are sought. Entirely new concepts as well as those significantly improvements are solicited.

PHASE I: The results of this effort will provide proof of concept by means of preliminary design, simulation, and/or laboratory experimentation.

PHASE II: The results of this effort will include hardware or components developed to a state where they can be demonstrated in a flight experiment.

A90-203 TITLE: Materials and Structures

OBJECTIVES: Development of advanced materials that fall into the following categories: metallic and nonmetallic composites, electronic and optical, diamond technology, space structures, superconducting, optical, and nuclear hard components.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: The objective of this program is to develop advanced materials useful of systems applications. ASAT system requirements emphasizes lightweight, nuclear hard high power hardware and components. These

diverse needs will benefit for the development and incorporation of advanced materials into all aspects of the ASAT program, including ground support, surveillance, and terminal kill.

PHASE I: The results of this effort will provide proof of concept by means of preliminary design, simulation, and/or laboratory experimentation.

PHASE II: The results of this effort will include detailed design, fabrication, evaluation of a working, but not necessarily optimized, breadboard or brassboard model.

PHASE III: The results of this effort twill include hardware or components developed to a state where they can be demonstrated in a flight experiment.

A90-204 TITLE: Directed Energy

OBJECTIVE: Develop innovative concepts for materials, components, design or architectures that will enhance the stat of technologies for directed energy.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: Orders of magnitude advancement in energy, on target propagation, beam control, target interaction and kill assessment are needed. Advancements in the areas of high-energy lasers, particle beams, microwaves or other directed energy devices are needed. Major enhancements in component technology such as ion sources, beam control devices, accelerators, neutralizers, optics, amplifiers, lasing materials, and plasmas are requested.

PHASE I: The results of this effort should prove feasibility through calculations, simulations, designs and preliminary experiments.

PHASE II: the results of this effort will include the detailed design, fabrication, demonstration, and testing and evaluation of a working preliminary breadboard model.

PHASE III: The hardware should be developed to the stage where it can be demonstrated in a flight test.

A90-205 TITLE: Surveillance and Early Detection

OBJECTIVE: Develop innovative surveillance and early detection sensors, devices, materials, components and architectures to advance the technology.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: Advances in surveillance and detection platforms, sensors, components, materials and architectures are needed. Significant evolution or revolutionary improvements in concepts or technology are required. Examples of areas to be explored are active and passive sensors, starting arrays, advanced radar concepts, surveillance platform concepts, advanced optics, detector materials, cryocoolers, platform stabilization and sensor pointing.

PHASE I: The results of this effort will provide evidence of concept feasibility through preliminary design, calculations, modeling and preliminary experiments.

PHASE II: The results of this effort will include detailed design, fabrication, demonstration and testing of a working, but not necessarily optimized breadboard model.

PHASE III: Hardware or component should be developed to a state where it could be demonstrated in a flight experiment.

A90-206 TITLE: Kinetic Energy Concepts and Technology

OBJECTIVES: Defense against satellites requires a highly efficient interceptor system. The goal of this research is to investigate and exploit concepts for advancing the state of the art in kinetic energy technologies.

CATEGORY: Basic Research

DESCRIPTION:

GENERAL: This program will focus on developments in all technologies, systems, and subsystems which may be utilized in ground, air, and space-based satellite interceptors. Propulsion, airframe and materials, guidance, control, and warheads are the principle subtechnologies of prime interest.
PHASE I: The Phase I effort will provide proof of principle reasonability by means of preliminary design, simulations, and/or laboratory experimentation.

PHASE II: The Phase II effort will build upon the feasibility of the Phase I results to provide demonstration through design, fabrication and testing of a breadboard/brassboard model.

PHASE III: Hardware or component will be developed to the flight demonstration stage.